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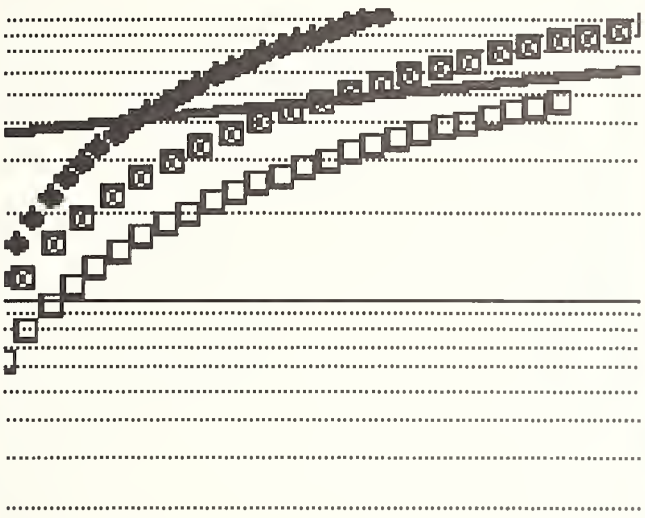
computing services

ComputerNews



You are cordially invited
to view our gallery of fine art.

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On display this month:

Terrain Elevation Data ....by PV~WAVE

General Linear Model Dialogue Box ....by SYSTAT

3D Wireframe Chart ......by DeltaGraph

Sample Text ....by Linkway

Plus exhibits by other electronic artists.

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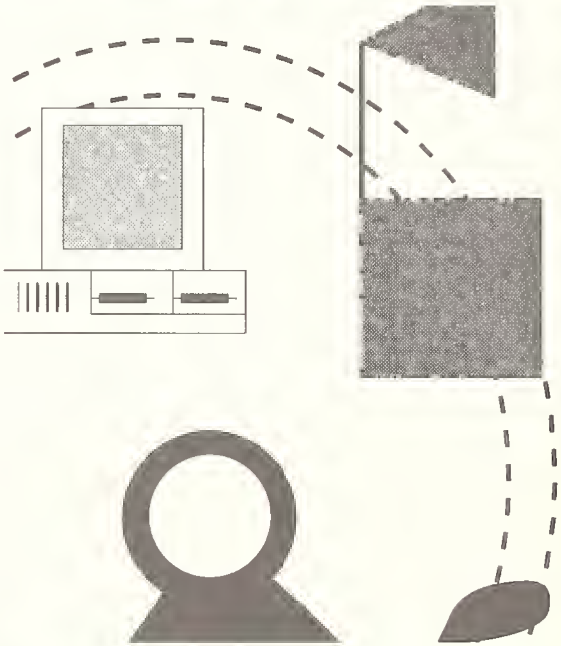
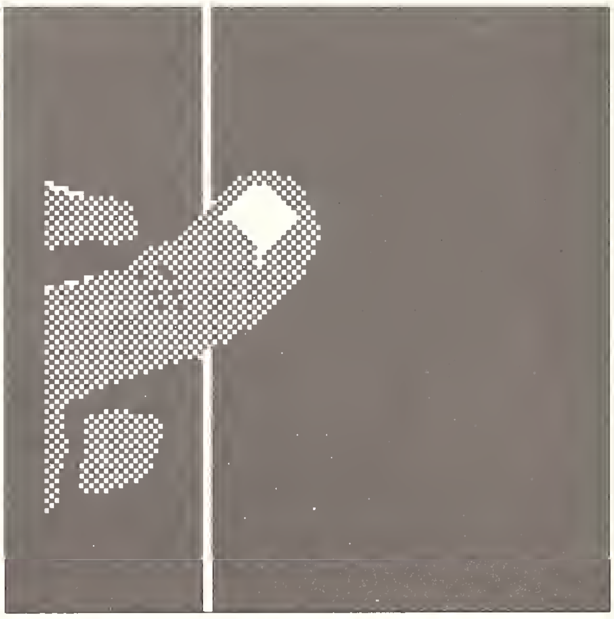
Location: ComputerNews
Date: January/February 1991
R.S.V.P. not required





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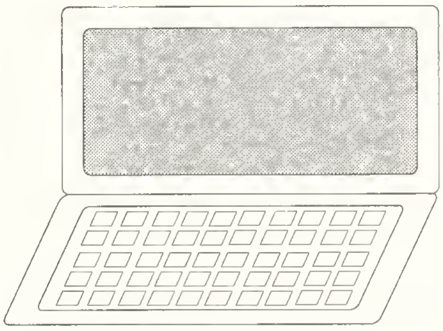
This newsletter was entirely produced on a Macintosh using PageMaker and other related Macintosh software.

COMDEX Fall 1990

COMDEX, the largest computer trade show ever, was held in Las Vegas last November. Manufacturers often save their biggest announcements for COMDEX. Industry pundits prowl the aisles, looking for signs that forecast the future of the business. While COMDEX is primarily a trade show for dealers and distributors of computer equipment, many businesses appreciate the unique opportunity to meet manufacturers directly and to expose their staff to a wide range of new products.

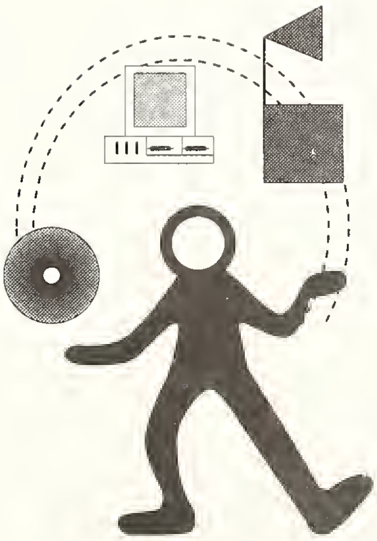
What Was Going On at COMDEX/Fall 90?



Notebook computers were everywhere. It seems as though every company has a notebook-size computer for sale. I gave up trying to count the number of vendors or even asking to have literature sent to me. There must be over 100 different brands of laptop/notebook computers on the market now; last year there might have been 20. Surveys indicate that notebook computers will capture half the sales of portable computers in the next two years. If you are in the market for a notebook computer, you can expect to see some very competitive pricing in the next 12 months.

Video and Multimedia

It seemed as though every aisle had at least one booth with a video camera or a VCR connected to a computer. This is in contrast to previous years when systems that integrated video with PCs were expensive and hard to find. Even harder to find were the customers who would buy and use the equipment. The cost of PC video has fallen, and the functionality and ease of use of the various systems has improved. It is easy to get excited about the teaching and research possibilities that the multimedia technology affords.



Large Capacity Disk Drives

The innovation in notebook-size computers and video processing is supported by a wide variety of choices in large disk drives using both magnetic and optical technology. Magnetic drives are getting both smaller in size and larger in storage capacity. The result is portable computers that weigh less then eight pounds, with 40 to 100 megabyte hard disks. Manufacturers are also combining hard disks into Disk Arrays to create systems that have many gigabytes of storage and faster access than a single drive.

David Sutherland
davids@gpu.utcs.utoronto.ca

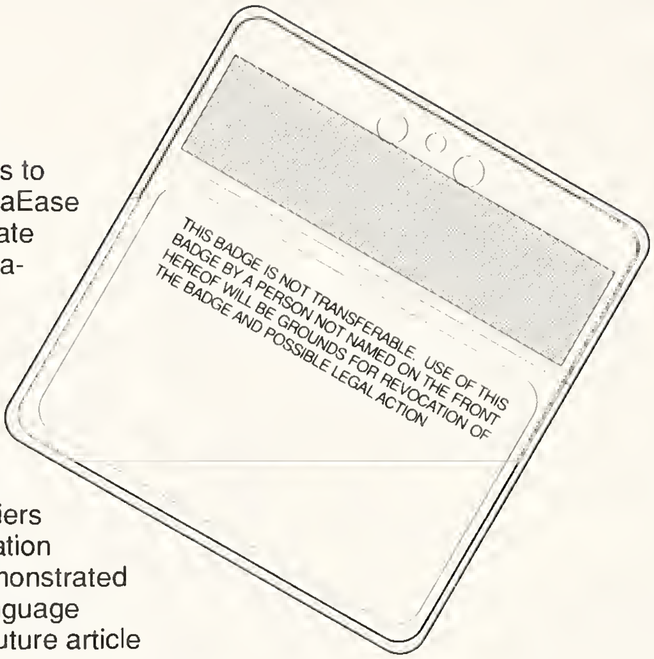
Around the Personal Computer Industry in Three Days

The daily tour of COMDEX started at about 8:30 in the morning and ended at 5:00 in the afternoon. I spent the entire time walking the aisles or talking to people in booths. I did not spend a lot of time looking at the major manufacturers, as their products can be seen easily in Toronto and are featured widely in the industry press. With so much to see, I asked many vendors to send me product literature. What follows here is a record of the exhibitors who caught my attention and with whom I spent some time talking.

Database Software

Database management software for personal computers is one of the responsibilities of UTCS's Microcomputer Support Group, so I spent a lot of time talking to different vendors. The most current database programs are much easier to use and more powerful than dBASE III (the most popular program on campus). Database programs can be divided into two camps, those that use the dBASE III/IV programming language and those that do not. The market leader of the dBASE camp is Ashton-Tate's dBASE IV. Borland's Paradox 3.5 leads the market in non-dBASE programs. My impression is that neither of the two leaders is the most functional program in its field. However, each database project needs to be assessed on its own combination of needs. On the subject of assessing database needs, we received evaluation software for AlphaFour, FoxPro, dQuery, DataPerfect, Clarion, DataEase, and Superbase 4 Windows. If you want to take a look at one of these, give me a call.

DataEase won first place in the "PC Week Labs Shootout: Database Development" (August 27, 1990 issue); since I had not worked with the program I was curious to see what it was like. DataEase has tools that let you create complex database applications without writing programs. One feature that I liked is the automatic incrementing of numeric strings, which simplifies the task of creating unique identifiers such as student identification numbers. DataEase demonstrated their structured query language (SQL) extensions. In a future article I will write about my experiences using their evaluation copy.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BADGE BY A PERSON NOT NAMED ON THE FRONT
HEREOF WILL BE GROUNDS FOR REVOCATION OF
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Precision Software demonstrated Superbase 4, their Windows 3.0 database manager. In addition to using the Windows graphical user interface (GUI), Superbase offers a rich set of application development tools and a programming language. DaVinci Computers demonstrated their video capture and playback card operating under the control of Superbase 4. Superbase 4 tied with Paradox for second place in the "PC Week Labs Shoot Out: Database Development".

Borland was demonstrating the latest release of Paradox, version 3.5. New features in version 3.5 include support for SQL, the ability to include Paradox Applications Language (PAL) functions in screen Forms and Reports, and the use of Borland's Virtual Real-time Object Oriented Memory Management (VROOMM) technology.

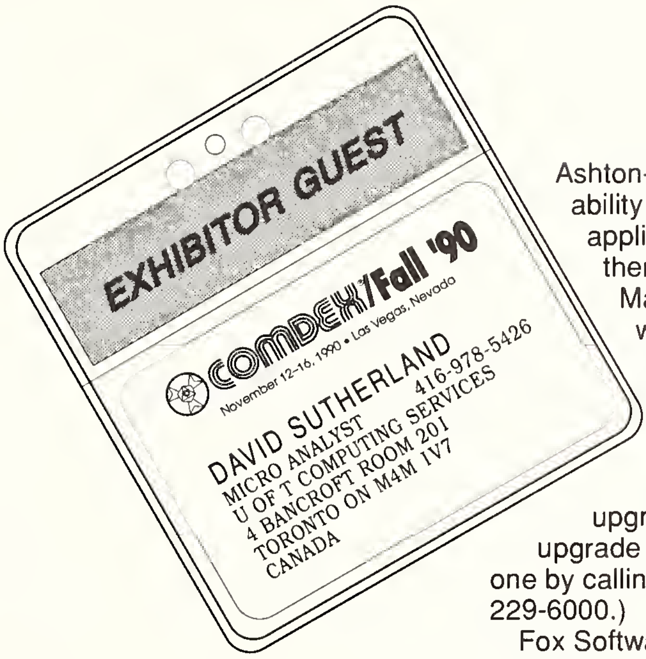
Quadbase was showing their dQuery program and I obtained a copy of their demo disk. dQuery is used to search a database for information and to format the information into a report. dQuery can search dBASE III files, Lotus 1-2-3 wks/wk1 files, and SQL databases.

Microrim's R:base 3.0 booth deserves special mention as the only company that gave me a t-shirt. One of their technical support staff demonstrated the program for me. R:base seems to offer a rich set of tools for developing multi-table database systems.

Progress is a relational database that runs under DOS, A/UX, and UNIX, and includes SQL support. While the program is very powerful, it seems to be focussed at programmers and database professionals rather than the average user.

Advanced Revelation 2.0 is a program that integrates information from a variety of sources. Its primary application seems to be the development of a single business application that can connect between a variety of institutional information resources. Revelation can access information located in dBASE III, ASCII, BTRIEVE, Microsoft's SQL Server, Sybase's SQL Server, Oracle, DB2, and Autocad files. Sophisticated menu systems to design screens and reports made the program appear to be quite easy to use.

Informic, a UNIX/DOS database manager, demonstrated support for scanned images, freeform text, audio, and motion video. Many UNIX workstations have superior colour graphics capability and Informic is a database management program that can take advantage of this feature.



EXHIBITOR GUEST

COMDEX/Fall '90

November 12-16, 1990 • Las Vegas, Nevada

DAVID SUTHERLAND 416-978-5426
MICRO ANALYST
U OF T COMPUTING SERVICES
4 BANCROFT ROOM 201
TORONTO ON M4M 1V7
CANADA

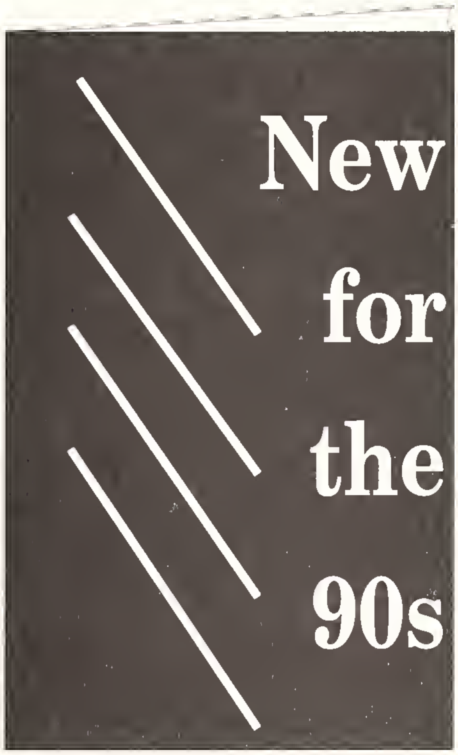
We have received several enquiries about WordPerfect's database manager, DataPerfect, so I tried to get some information. The WordPerfect booth was too loud for me and I couldn't find anyone who knew a lot about the program, but I did manage to obtain a DataPerfect demonstration diskette. While DataPerfect has many good features to recommend it, people who are familiar with WordPerfect (the word processor) and are looking for a program that is easy to use will be disappointed by DataPerfect's complexity.

Another non-dBASE database manager is DataFlex 3.0 / Flex SQL. Again, this program appeared to be very capable. If the vendor sends us an evaluation copy, we will let you know more about it in a later issue.

One of my most productive sessions was spent talking with Daniel Small, a dBASE IV consultant at the Ashton-Tate booth. He listened to the problems that I had encountered with dBASE IV, acknowledged shortcomings in the product, and pointed out workarounds and features that provided other benefits. I am confident that dBASE will ultimately offer the tools to develop a database application without programming. Unfortunately, this has not been achieved yet.

Ashton-Tate was pushing their ability to develop a database application for the PC and then move it over to a Macintosh or a SUN workstation. Some research projects might find this useful. (By the way, if you have version 1.0 of dBASE IV you can and should upgrade to version 1.1. The upgrade is free; you can order one by calling Ashton-Tate at (416) 229-6000.)

Fox Software has created a family of dBASE-compatible database managers that many professional programmers consider to be better than the original dBASE. At COMDEX, Fox showed a beta release of FoxPro version 2.0. This latest release of the program combines extraordinary speed and many programming productivity tools. With the release of FoxPro 2.0, both the PC and Macintosh programs will be united. We have an evaluation copy of FoxPro version 1.03 in the office, as well as FoxBASE+/Mac.



The ORACLE booth demonstrated multi-vendor connectivity. Over 20 different vendors were connected to an ORACLE SQL server via a local area network. Programs like Paradox and DataEase on the PC, and Omnis 5 and Dataprism on the Macintosh, were all working with the same ORACLE SQL database server running on a Compaq SystemPro.

Network Servers

Last year Compaq announced the SystemPro line of multi-processor network servers. These machines are designed to use more than one central processing unit (CPU) along with very large hard disks. This year, Advanced Logic Research (ALR), Everex, and WYSE demonstrated their network servers, all costing thousands of dollars less than the models from Compaq. If you need a high-performance fileserver or SQL database server running either UNIX or Novell, you have the opportunity to do some comparison shopping.

Other Stuff

Lynx Computers showed a line of very small footprint (9" x 6" x 1.5") desktop computers with 10-inch monitors. These looked very attractive; later I saw several other manufacturers showing machines with a similar form factor. I expect to see dealers in Toronto offering these mini-desktop systems soon.

POWERCARD was showing an interesting type of personal uninterruptable power supply. The Powercard product senses when the computer has lost power and keeps the machine running long enough to freeze your program and save all the memory to disk. When power is restored, you have the option of resuming the operation of the computer exactly where it left off. The Powercard is being sold for

US$200, plus shipping. This looks like a good combination of price and functionality for people who need to protect their work and who don't need to run their computers continuously.

I had to go all the way to Nevada to see the Micro Slate touch-screen laptop, which is designed and manufactured in Quebec. The surface of the VGA-compatible back-lit liquid crystal display (LCD) screen is touch sensitive, allowing the user to indicate responses by pressing the appropriate symbol displayed on the screen. This computer would be most useful for creating portable and easy-to-use data-entry terminals, possibly for field surveys or medical records. Micro Slate offers a program that simplifies the creation of custom data-entry screens.

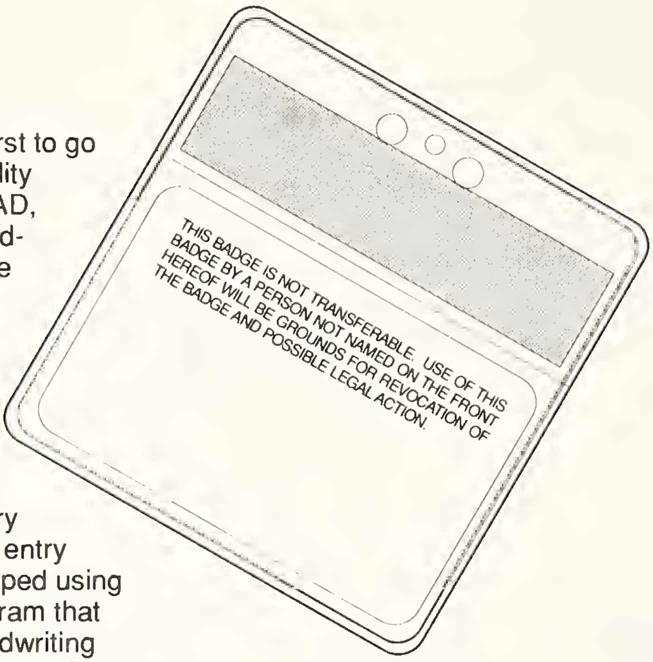
Another Canadian company, Cemcorp, was demonstrating their remarkably inexpensive PC video overlay card that sells for CDN$300. This card doesn't do fancy video processing, but it just might do the trick if you need to pull up a sequence from a video disk.

Many years ago I was working with a public information project that was using Elographics touch screens as the user input device. It was difficult to install the touch screen on the monitor and to get the software to work. Now Elographics offers integrated packages with the screens installed on the monitor, and special drivers for Windows 3.0 that make the touch screen work like a mouse. I was impressed.

GRiD systems is the first to go to market with a commodity laptop called the GRiDPAD, which can recognize handwriting. You can't use the GRiDPAD to write your latest novel or research paper by hand, as the handwriting capabilities of this computer are intended to be used for filling in data entry forms. The data entry forms are developed using Padbase, a program that provides the handwriting extensions to the dBASE and Clipper languages. Like the Micro Slate, the GRiDPAD might be useful for entering medical or survey information.

If you are using MS-DOS and need to run several programs at the same time, DESQviews' Quarterdeck has been the program of choice for several years now. The program continues to improve. If you are doing custom programming, QuarterDeck supports most of the major PC-compatible languages, providing a much simpler route to multitasking than Windows 3. DESQview is also providing connectivity to the UNIX world with their implementation of X-Windows. With X-Windows running on your PC, it is possible to take advantage of many of the sophisticated graphical programs that run on UNIX workstations.

The PLANAR/FINLUX flat panel electroluminescent displays caught my attention. These are gas plasma displays either 12" x 14" x 3" deep, or 10" x 8" x 3" deep, with controllers for either a Macintosh or a PC. These small units can be mounted on an arm (à la Luxo Lamp) clamped to your desk. In this configuration, the screen can be moved out of the way when you don't need it. I was told that the power levels in the displays were much lower than conventional cathode-ray-tube (CRT) equipment, and as a result the plasma displays created less electromagnetic interference. People with health concerns might find this an attractive feature of the technology.


THIS BADGE IS NOT TRANSFERABLE. USE OF THIS
BADGE BY A PERSON NOT NAMED ON THE FRONT
HEREOF WILL BE GROUNDS FOR REVOCATION OF
THE BADGE AND POSSIBLE LEGAL ACTION.

More to Come

The products covered in this article represent only those that I made notes about while at COMDEX. Every day my mailbox is filled with brochures and catalogues from companies that I contacted at the show. We will continue to keep you posted, here in *ComputerNews,* of anything interesting that we find. Also, if there is something specific that you need, or if you want advice on purchasing equipment, call David Sutherland at 978-5426.

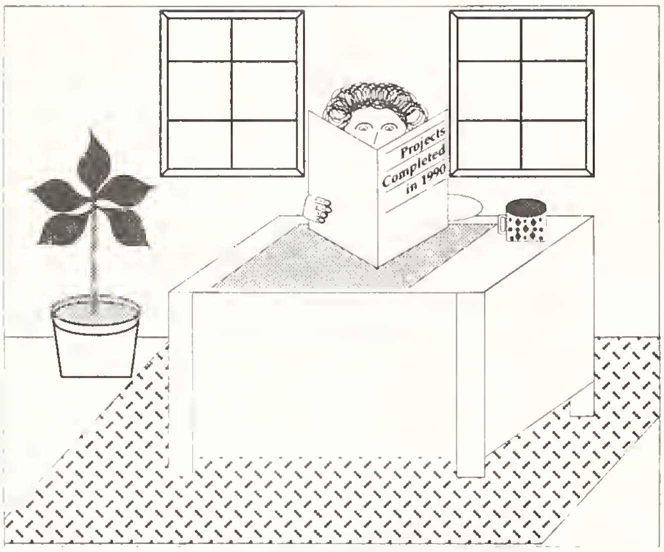
Computing Communications

News from UTCC

What We've Been Doing...

The Department of Planning and Coordination has prepared a report outlining projects completed by all departments in the Division of Computing and Communications during the period May 1 to October 31, 1990. It is being circulated to Principals, Deans, Directors, and Chairs of departments. If you did not receive a copy but would like to see one, call Eva Swenson at 978-5138, or send electronic mail to *eswenson@vm.utcs.utoronto.ca*.

Eva Swenson
eswenson@vm.utcs.utoronto.ca



ProComm Communications Program Seminar

Monday, March 25, 1991 *10:00 a.m. - 12:00 p.m.*

ProComm is a general purpose communications program currently available to all U of T faculty, staff, and students. It is suitable for connecting to the many networks on campus.

A seminar has been scheduled to introduce ProComm and its various features: terminal emulation (a number of popular ones will be reviewed); the dialing directory; file transfer protocols, such as Kermit and XMODEM; configuration and modem parameter settings; and the DOS gateway, which allows you to execute DOS commands and other programs while you are still in ProComm.

There is a fee for this seminar. Copies of ProComm are made available at no charge to members of the University, but you must bring your own diskettes (two 5.25" or one 3.5").

To reserve a place in this seminar, please contact Irene Rosiecki at 978-4565.

Free NetNorth (Electronic Mail) Demonstration

Monday, March 25, 1991 *12:30 - 2:30 p.m.*

Anyone interested in sending documents to colleagues or friends reliably, quickly, and inexpensively will not want to miss this demonstration. We will introduce you to the NetNorth/BITNET/EARN communications network, which is accessible from the CMS system. This network connects more than a thousand universities and research institutes in Europe, Asia, and North America. Sending documents or files over the network is very easy to learn.

We will show you how to send mail and files to another institution, and how to talk directly to someone on the network. ***Please note this is a demonstration only.***

Space is limited. If you would like to attend one of these sessions, please contact Irene Rosiecki at 978-4565 to reserve a place.

NCRIPTAL/ EDUCOM Software Awards

The EDUCOM Higher Education Software Awards program is now accepting entries for its 1991 competition. This year, a two-year alternation of eligible disciplines begins. For 1991, entries will be accepted in undergraduate Humanities, Engineering, and Mathematics, as well as graduate Law. The 1992 competition will include Social Sciences, Natural Sciences, and Accounting. The deadline for completed applications is March 11, 1991.

To request a complete packet of application materials for the 1991 Awards Program, call Deanna Migut, the Awards Program Coordinator, at (313) 763-5325. If you would like to review the general information distributed by NCRIPTAL/EDUCOM, call Eva Swenson at 978-5138.

Scientific Visualization Software

Andrzej J. Pindor
apindor@vm.utcs.utoronto.ca

Modern science and technology have a tendency to produce ever-increasing amounts of data as a way to describe different aspects of reality. This data may come from increasingly sophisticated equipment, such as the Hubble Space Telescope, a tomographic brain scanner, an array of seismographic sensors, and so on. It might also come from a supercomputer as a result of a detailed simulation—air flow around an aircraft, for instance. Scientific visualization is the process of manipulating this data in such a way that we can "see" different aspects of it and comprehend more easily the relationships it contains. Below, I describe **PV~WAVE** (Precision Visuals Workstation Analysis and Visualization Environment), a program that runs on all SUN and DEC workstations and on large VAX systems, and two sets of programs for scientific visualization on Macintosh II computers. All the programs I describe make intensive use of colour in the process of representing data. Since *ComputerNews* is not printed in colour, this aspect of Visual Data Analysis (VDA) software cannot be illustrated here. You will have to rely on my descriptions, with the help of your own imagination.

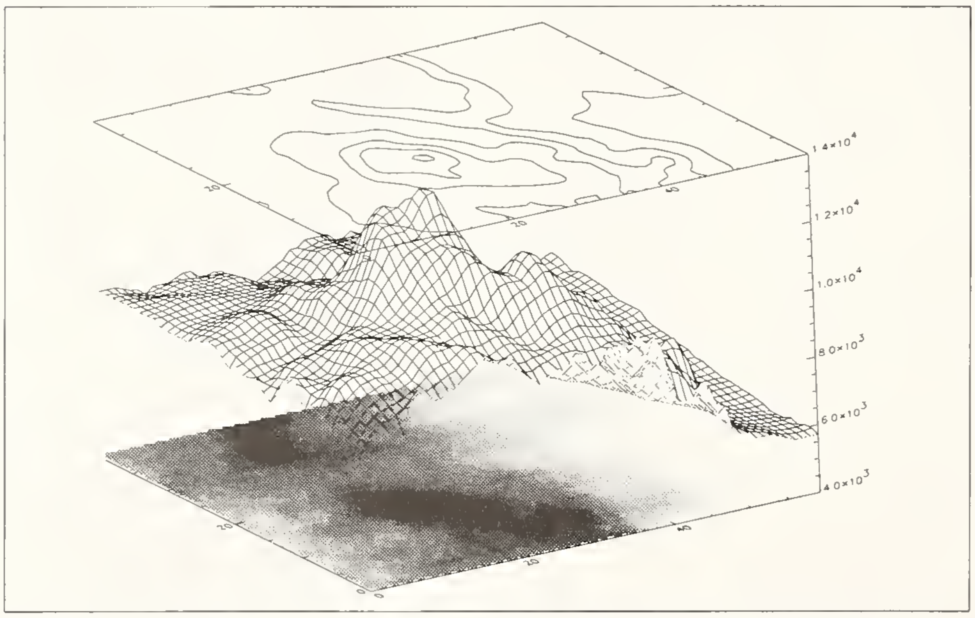


Figure 1: Representing four-dimensional data with PV~WAVE. The middle part of the picture shows terrain elevation data from the Pikes Peak region of Colorado as a surface, the top shows the contour map of the same region, and the bottom represents accumulated snow depth in the region.

PV~WAVE

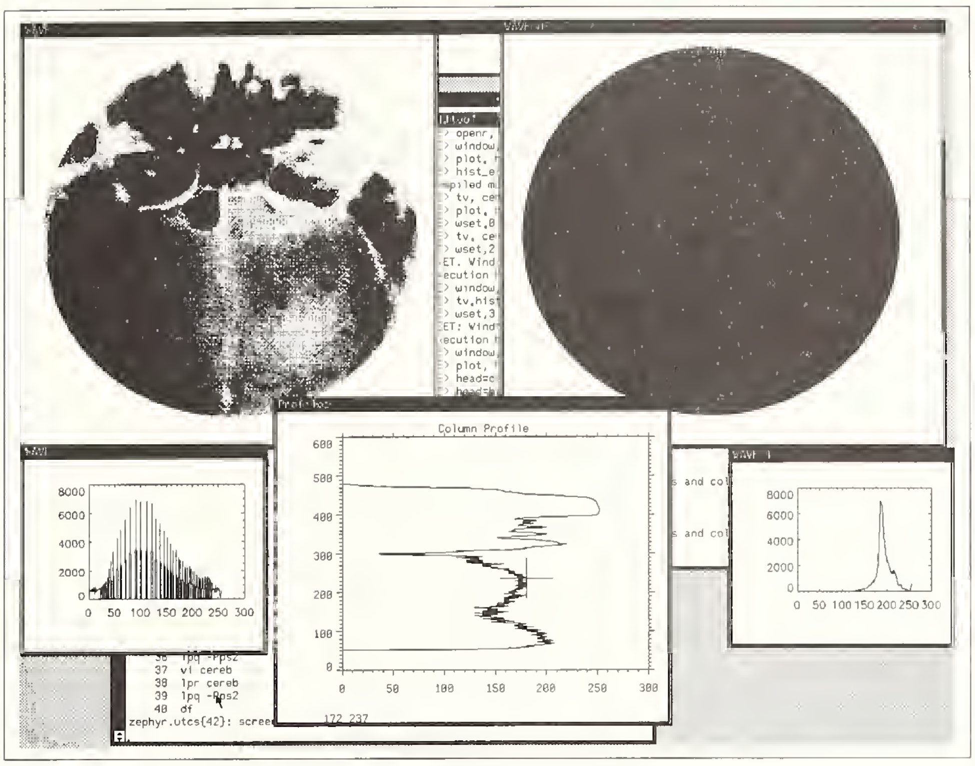
PV~WAVE is interactive software for visualizing and analyzing technical data. It consists of a set of high-level interpretive commands and procedures which provide you with powerful features:

i) data access, reduction, and analysis;
ii) two-dimensional (2D) and three-dimensional (3D) graphics;
iii) dynamic graphics, including animation;
iv) image processing and manipulation;
v) application development.

The vendor supplies a gallery of state-of-the-art examples of data visualization created with PV~WAVE. Many of the examples are truly impressive, even from a purely visual point of view.

Using PV~WAVE

PV~WAVE can read easily almost any kind of data: standard ASCII files, both in free format and with a specified format, and unformatted data of various types; for instance,



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> tv, ce
> plot,
> wset,0
> tv, ce
> wset,2
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> window,
> tv,hist
> wset,3
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ecution
> window,
> plot,
> head=c
> head=h
```

```
37  vi cereb
38  lpr cereb
39  lpq -Pps2
40  df
zephyr.utcs{42}: scree
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Figure 2: X-ray image of cerebrum before pixel equalization (top right) and after (top left). Histograms at bottom left and bottom right show corresponding pixel distributions. Bottom middle diagram shows column profile from the top left image.

the program can read data stored in External Data Representation format (which makes binary files portable across UNIX platforms) or as output by a FORTRAN program. Data can also be written to a file in any of the above-mentioned ways. There is a number of tools for data subsetting, smoothing, filtering, manipulation, and analysis. A full complement of elementary functions is available (including Bessel, Gamma, and Error functions), and a number of matrix operations like inversion, singular value decomposition, LU decomposition, and others. There is a Fast Fourier Transform available, a routine for solving a set of linear equations, and several statistical routines (e.g., min, max, standard deviation, correlation, and random number generation).

As befits VDA software, PV~WAVE has a large variety of graphics routines. *Figure 1* shows some of the routines in action, illustrating also a method of visually representing four-dimensional data. The surface is a representation of terrain elevation data from the Pikes Peak region of Colorado. The plane at the top is just a contour map, but the bottom plane shows the distribution of an additional variable: accumulated snow depth in this region (the darker the colour the more snow it represents). You could also code this information using the colour spectrum.

Another powerful tool for the visual exploration of data is animation. PV~WAVE makes creating animation very easy. For instance, a twelve-line procedure will rotate a surface (the one in the middle of *Figure 1,* for example) continuously in a separate window. Another example of dynamic graphics is illustrated in *Figure 2*. In the upper left corner of *Figure 2* we see an "improved" X-ray image of a cerebrum. The command "PROFILES" will put a cursor into this window and create an additional window showing a row or column profile of the image at the position of the cursor (see middle bottom of *Figure 2*.) Pressing the left cursor on the mouse toggles the window's display between column and row profiles; the cross in the profile window shows where the cursor is currently positioned on the profile. When you move the cursor around in the image, the profile changes continuously, corresponding always to the position of the cursor, thus allowing you to investigate the image interactively. To perform a screen dump (which I did to create *Figure 2*), the cursor had to be moved to another window; consequently, the profile shown corresponds to the position of the cursor before performing the screen dump.

In the top right corner is the original X-ray image of the cerebrum. Not many details can be distinguished; the reason for this is shown in a histogram of the image displayed below the image. Pixel values are concentrated in a narrow subrange of the possible values. PV~WAVE's "hist_equal" procedure spreads the distribution of pixel values so that each range contains an approximately equal number of pixels. This results in an improved visual display of the information content, as you can see in the upper left corner of *Figure 2*. The corresponding histogram is shown in the bottom left of *Figure 2*.

PV~WAVE uses an interpreted language. When you invoke PV~WAVE, you will see a brief introductory message and then the prompt "WAVE>". At this point, you can enter PV~WAVE commands directly, manipulating and displaying data in various ways. Alternatively, a series of PV~WAVE commands can be stored in an external file (either as a log of a session, or independently, using any available editor) and then be replayed from this file. Frequently-used series of commands can also be organized into "procedures." To use a procedure in a PV~WAVE session, you first compile it (using the "run" command); then you can treat it as another PV~WAVE command. *Figure 1* was created with a help of such a procedure, which combines three PV~WAVE graphics commands: CONTOUR, SURFACE and TVSCL (which is used to display pixel images). PV~WAVE's programming language contains commands for creating windows, accepting input from the mouse, and so on, allowing you to create highly-sophisticated applications for interactive data examination. The vendor-supplied demonstration contains a number of excellent examples of such interactive applications.

PV~WAVE graphics can be output to different hard copy devices, such as an HP plotter, HP LaserJet printer, or a QMS printer; they can also be sent to a PostScript or a CGM file. *Figure 1* was obtained from a PostScript output file.

In conclusion, PV~WAVE is a highly-sophisticated visual data analysis package, which could be very useful in any field where large amounts of data are created and analyzed (for instance, to analyze data produced by supercomputer simulations). Although I have not tested this myself, PV~WAVE apparently is quite fast on its matrix operations, faster than corresponding FORTRAN programs.

In the course of evaluation I have contacted PV~WAVE's technical staff a number of times. I have found them to be very friendly and prompt in responding to my queries and complaints.

Vendor:
Precision Visuals, Inc.
6260 Lookout Road
Boulder, Colorado 80301
USA
Phone (303) 530-9000
Fax (303) 530-9329

Hardware Requirements:
All SUN and DEC workstations and large VAX systems.
Supports SunView, X Windows, Tektronix 4000, 4100 and 4200 series graphics terminals and DEC graphics terminals.

Pricing:
Precision Visuals offer two types of licenses: 1) one machine with multiple users, and 2) one user with many machines (network environment).

The cost of the first license depends on the type of computer. For SUN3 it costs US$2880, for SUN4/200 (and Silicon Graphics) it costs US$4350. The second license costs US$2700.
(These prices apply to educational institutions.)

NCSA Software

The National Center for Supercomputer Applications (NCSA) in the United States offers a number of scientific visualization programs for free. Below I shall describe two such programs for Macintosh II-series computers: **NCSA DataScope** and **NCSA Image.**

NCSA DataScope

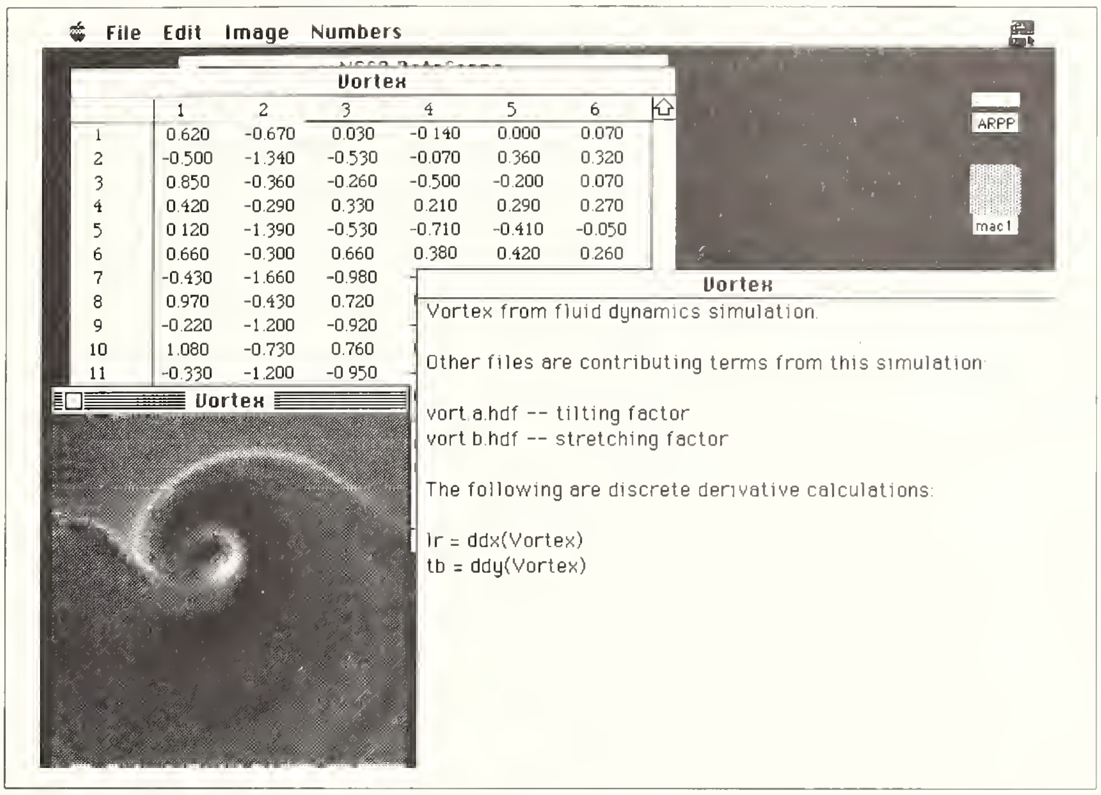
NCSA DataScope is an interactive data analysis tool which allows you to:

- display 2D data (32-bit floating-point) in a spreadsheet;
- scale and generate colour images from the data;
- find data values that correspond to points on an image;
- enter and save comments and notations along with data;
- apply calculations from internal and external functions to data to generate derived data sets.

The program exploits fully the Macintosh graphical user interface; it is assumed that you are familiar with such procedures as positioning the pointer, clicking, dragging, selecting an item from a menu, and so on. Online help is also available.

Using NCSA DataScope

To analyze a data set, first you load it into DataScope. At this stage three windows are activated: a text window, where the data is displayed in a spreadsheet form; an interpolated image window showing a raster image of the data; and a notebook window where you enter any text describing the



	1	2	3	4	5	6
1	0.620	-0.670	0.030	-0.140	0.000	0.070
2	-0.500	-1.340	-0.530	-0.070	0.360	0.320
3	0.850	-0.360	-0.260	-0.500	-0.200	0.070
4	0.420	-0.290	0.330	0.210	0.290	0.270
5	0.120	-1.390	-0.530	-0.710	-0.410	-0.050
6	0.660	-0.300	0.660	0.380	0.420	0.260
7	-0.430	-1.660	-0.980			
8	0.970	-0.430	0.720			
9	-0.220	-1.200	-0.920			
10	1.080	-0.730	0.760			
11	-0.330	-1.200	-0.950			

Vortex from fluid dynamics simulation.

Other files are contributing terms from this simulation:

vort.a.hdf -- tilting factor
vort.b.hdf -- stretching factor

The following are discrete derivative calculations:

lr = ddx(Vortex)
tb = ddy(Vortex)

Figure 3: NCSA DataScope screen with three main windows open.

data set (which can be saved along with the data), as well as enter calculations to perform desired transformations of your data. *Figure 3* shows the DataScope screen with the three aforementioned windows open.

The *File* menu allows you to open (load) a data set, save a data set (after performing some transformations on the original data, for instance), and also load a colour palette (several colour palettes come with the program, and there is a separate NCSA program to create new colour palettes).

The *Edit* menu is used to move selected text between the notebook window or image window and the Clipboard.

The *Image* menu allows you to create a scaled colour raster image from the active data set. Polar images can also be created, and there are options for controlling image size.

The *Numbers* menu has the following commands:

- *Attributes* which allows you to alter text window characteristics: variable names, display format, maximum and minimum values of interest, and the range of the colour palette to be mapped to the data set;
- *Synchronize* which synchronizes selections of data values in multiple data sets across windows (this means that any operation on a data value in one window will be reflected in all synchronized values);
- *Extract Selection* which causes the selection to be treated as a new, independent data set, and displays it in a new text window;
- *Calculate From Notes* which applies the selected formula to the active data set;
- *See Notebook* which makes the Notebook window active.

NCSA DataScope reads floating-point or ASCII data from Hierarchical Data Format (HDF) or text files, respectively. HDF is a flexible, standard file format designed at NCSA for sharing graphical and floating-point data between different programs and machines.

In conclusion, NCSA DataScope is an interactive program which may be very useful for analyzing and manipulating two-dimensional data. It is worth stressing that it is free.

System Requirements:
Macintosh II with 256 colour capability, 1MB RAM, and system software version 5.0 or later. Better performance is obtained using system software version 6.0.2 or later.

Availability:
If you are interested, contact Andrzej Pindor at 978-5045.

NCSA Image

NCSA Image allows you to use colour, contour plots, 3D plots, shaded data plots, XY graphs, and ordered dither plots to display sets of data points. You can also display the actual floating-point numbers, animate multiple raster images, and modify and save colour palettes. As in the case of NCSA DataScope, you are expected to be familiar with Macintosh procedures. Online help is also available.

Using NCSA Image

When you invoke NCSA Image (by double-clicking on its icon), a palette window displaying the range of the current palette appears at the lower edge of the screen and a startup box appears above it. You have to remove the startup box by clicking anywhere on it. At this stage, an empty screen with menu items at the top appears, and you are expected to load a data file or a palette.

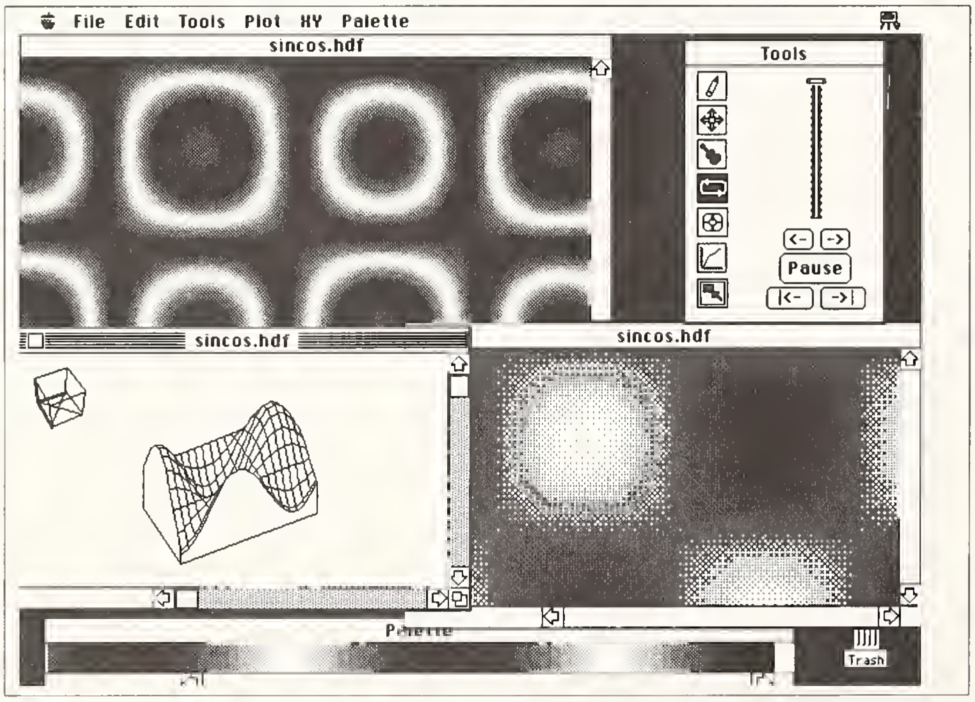
NCSA Image can read two types of files, raw raster files or HDF files (described in the section about NCSA DataScope), and also user-defined palettes. If your data is in ASCII format, you have to convert it to HDF format first. You can do this either by using public domain software from NCSA designed for this purpose, or by going through the NCSA DataScope program (see above) that reads ASCII data and can save the data in HDF format. *Figure 4* shows the NCSA Image screen with several windows open and the main menu at the top:

- *File* allows you to open (load) and close files, and also to start an animation (if you have a set of images stored).
- *Edit* is used to copy a whole image, part of an image, or a palette into the Clipboard, and to paste the contents of the Clipboard into NCSA Image.
- *Tools* makes it possible to magnify or reduce the image in the active window; this can be done either by duplicating pixels or by interpolation. You can also plot a histogram of the data values, adjust the colour table to enhance the representation of the image data, and specify a base colour other than white, which is the default. This is where you open the Tool Chest, seen in the upper right corner of *Figure 4.*

  The Tool Chest is used to manipulate the colour palette, make selections, and choose data sets to be graphed in an XY plot. Controls on the right-hand side of the Tools window determine the rotation of palette colours.
- *Plot* allows you to view the data in five different ways: as a colour raster image (see *Figure 4;* due to the absence of colour in *ComputerNews,* the image is represented in grey scales); as a contour plot; as a 3D plot (lower left corner of *Figure 4*); as a shaded data plot; and as an ordered dither plot (lower right corner of *Figure 4*). The 3D plot can be rotated interactively with a mouse, using the Angle Cube visible in the upper-left corner of the 3D window.
- *XY* is used to generate 2D plots from a line you select in the image window. It allows you to overlay several plots, to title axes, to add legends, and so on.
- *Palette* is used for various operations involving colour palettes, such as loading a new palette, restoring default settings, saving changes to a palette, and so on.

In conclusion, NCSA Image is a useful program for the visual analysis of data on a Macintosh computer, and again, it is free. If you are interested, please contact Andrzej Pindor at 978-5045.

Figure 4: NCSA Image screen with several windows open.



Hardware Requirements: Macintosh II with 256 colour capability, at least 1MB RAM (It will run on a non-colour equipped Macintosh, but many of its features will be lost.) To run animations you need as much memory as possible. It may also be run on SuperMac and RasterOps 8-bit graphics. It will also run on an SE, but you will sacrifice speed.

Spyglass Software

Spyglass Inc. has kindly sent me four of their data visualization programs for the Macintosh for evaluation. Three of these programs, **TRANSFORM, VIEW,** and **FORMAT** are commercial, enhanced versions of NCSA software. In addition to the specific enhancements discussed below, Spyglass Inc. software includes a Libraries diskette with the following folders:

- *LaserWriter* containing the latest LaserWriter drivers supplied by Apple;
- *32-Bit QuickDraw 1.0,* which contains the 32-bit extension to colour QuickDraw for systems 6.0.3 and 6.0.4;
- *2D File Examples,* which includes examples of reading and writing HDF files from FORTRAN programs, along with a compiled HDF library that has been tested with the Language Systems FORTRAN compiler for the Macintosh Programmer's Workshop (MPW);
- *3D File Examples,* similar to 2D File Examples, for 3D data sets to be used with Spyglass Dicer (see below).

It is also worth mentioning that Spyglass Inc. offers full user support for its products (NCSA software is, in principle, unsupported).

Spyglass TRANSFORM

TRANSFORM is an enhanced version of DataScope. A number of functions, such as changing the window size, or changing the data display format, are now easier to use. Several new features have been added. For instance, in the Edit menu the Undo command is now operational; in the Image menu two new commands have been added: one for generating line graphs of column or row data, and another one called Color Bar. The latter shows you the colour table used to generate an image, the minimum and the maximum data values in the data set, and a histogram of all data values. Two new main menu items have been added: Tables, which offers a choice of 17 different colour palettes; and Window, used to organize the windows on the screen. Finally, the Print command has been added to the File menu to allow you to print a current window on LaserWriters, PostScript printers, and many colour printers.

System Requirements:
Macintosh II-series computer equipped with 256 colour capability, at least 1MB RAM, and system software 6.0 or later. Hard disk recommended.

Price:
US$198

Spyglass VIEW

Spyglass VIEW is an enhanced version of NCSA Image. As in the case of TRANSFORM/DataScope, several functions are easier to use and new features have been added. For example, there are two new menu items, Tables and Windows. VIEW can read and create PICT files. Palette creating capabilities have been enhanced considerably. The Print command is also available in the File menu.

System Requirements:
Macintosh II-series computer equipped with 256 colour capability, at least 1MB RAM, and system software 6.0 or later. Hard disk recommended.

Price:
US$198

Spyglass FORMAT

Spyglass FORMAT is an enhanced version of NCSA Layout. Both of these programs are designed to create annotated graphs and animations for the purpose of presentation. I may review these programs in a future issue of *ComputerNews.*

Price:
US$98

Spyglass DICER

The purpose of Spyglass DICER is to display 3D volumes of data, for instance, the density of gas in a region of 3D space (other examples might include the density of brain tissue inside a skull, the temperature distribution inside a star, and so on). This is achieved by creating planes inside the volume of interest, and by representing the values of the relevant variable (density, temperature, and so on) at points in these planes by using different colours or shadings. The planes may be formed either by simple slices through the volume or as faces of blocks. This is illustrated in *Figure 5* (see page 12) where the left side of the window shows a series of slices through the data region. (The data in question comes from a hydrodynamic simulation of a narrow-angle-tail radio jet, and shows spatial distribution of gas pressure). The middle window shows an example of two overlapping blocks with a cut-out region combined with a horizontal slice. The window on the right is used to change the orientation of the data region by rotating it around any of the three axes, and also to change the direction of the view.

At the top of the middle window you can see a series of icons. The left-most one of them is used to create blocks, and the next one to make cut-outs in blocks. The three following icons are used to make

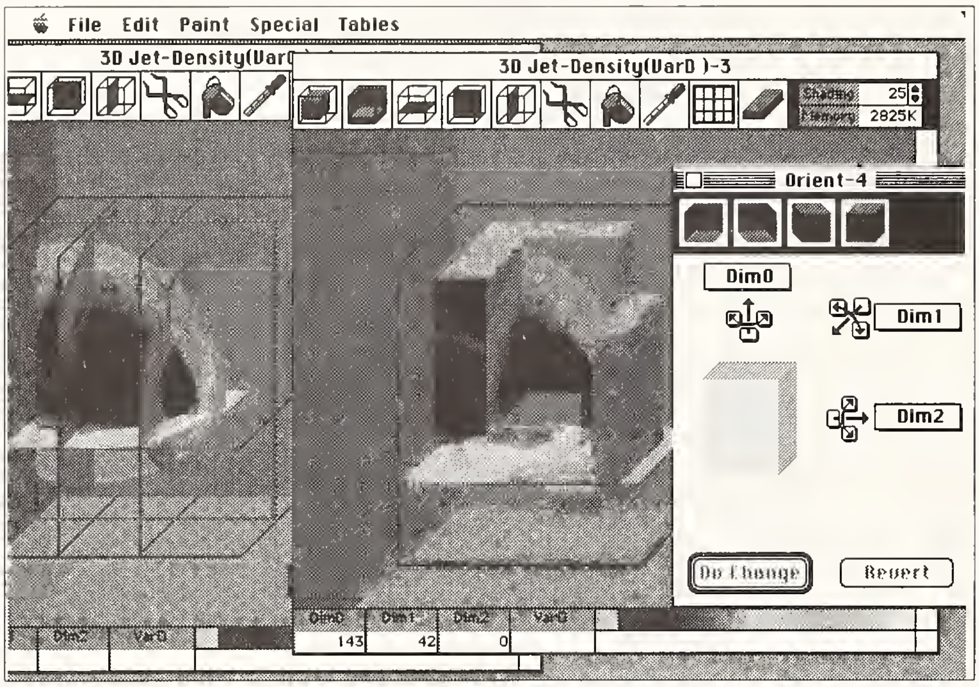


Figure 5: Spyglass DICER screen showing slices through a 3D data region (left window), overlapping blocks with a cutout, and orientation window.

slices parallel to the three faces of the data region. The next icon (pair of tongs) is used to move slices or blocks. The paint bucket tool and eye dropper tool icons are used to manipulate colours; the next icon, called the transparency tool, is used to make selected colours transparent. This is a very useful feature; you can see its application in the left-hand window, where the background colour was made transparent. The eraser tool icon is used to restore colours.

The main menu items have the following functions:

- *File* is used to open a data file; to change parameters like colour scaling, zooming factor, and so on; to open a new window; to close the current window; to control printing; and to quit DICER;
- *Edit* removes, copies, and pastes selected data objects;
- *Paint* allows you to control the use of colours, including transparency;
- *Special* menu commands determine when the updating of any action will be done (immediately or on demand), bring up the orientation window (right-most window in *Figure 5*), and change front-to-back scaling;
- *Tables* menu commands let you choose different colour tables, or load a colour table from disk.

Visualizing 3D volume data is not an easy task. Spyglass DICER does a very good job in this respect. It is easy to use, performs fairly fast, and its functions are very intuitive. I am sure that anyone dealing with volume data would not only have great fun using this program, but would also find it a great help in making sense of the data. In a short article it is hard to demonstrate all the interesting features of the program and impossible to show the effective use of colours (I am limited to grey-scale figures). If you would like to try the program yourself, you are welcome to do so. If you are interested, call me at 978-5045.

Figures 3, 4 and *5* were created using a screen capture program, since I wanted to show what the screen looks like with the main menu and several windows visible. The Print command in the File menu is supposed to print just the active window. When I tried it, however, I ran into problems. First, I was getting just a black rectangle. When I called Spyglass, I was told that probably I had an old version of the LaserWriter printer driver (version 5.2), and that I should use version 6.0 supplied on the Spyglass Libraries diskette. I copied the corresponding files from the Libraries diskette (LaserWriter, LaserPrep, and PrintMonitor) to the System folder, but when I tried to print I received an error message saying that I have an incompatible version of LaserPrep. Finally, I did succeed in getting a nice, grey-scale print of the DICER window, but only after using a LaserWriter driver and LaserPrep version 6.0.1 from an external source. The Spyglass technical adviser to whom I reported the problem was very surprised and promised to investigate.

Hardware Requirements:
Macintosh II-series computer, equipped with 256 colour capability, 2MB RAM (4MB recommended), system software version 6.0.3 or later. Hard disk highly recommended.

Price:
US$249. If you buy all four Spyglass programs, the package price is US$598.

How to Analyze Repeated Measures Designs Using SYSTAT

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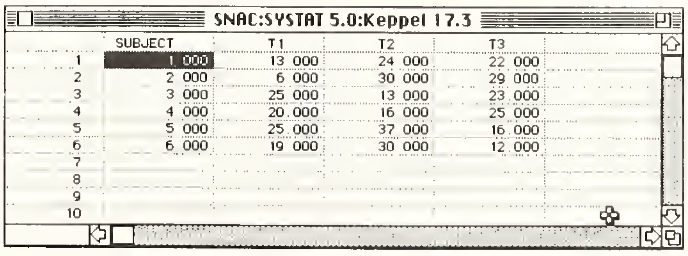
In this article, I discuss how to analyze repeated measures designs using SYSTAT version 5.0 for the Macintosh computer. I will make a few comments about other SYSTAT versions at the end of this article. To ease confusion for users of different software, I have decided to write a separate article on the same topic for SPSS. This article will appear in the next issue of *ComputerNews*.

The first article on repeated measures designs, in *ComputerNews* November/December 1990 (page 27), discussed how to analyze these designs using SAS. Important terminology, such as *data presentation method* and *data analysis method*, was defined and discussed at length in that article. I will assume that you have read the first article, that you are familiar with analysis of variance techniques and terminology, and that you know to use SYSTAT 5.0's command menus. The example data sets I will be using in this article are the same data sets that I used for discussing the analysis of repeated measures designs using SAS.

The first design example is taken from Keppel, 1982, Section 17.3. This design has one within-subject factor (treatment) where each of the six subjects has been given all three treatments. When the data are entered into SYSTAT's data editor in the multivariate presentation method, there are four columns, subject number and the results from each of the treatments, and six rows (see *Figure 1*). With this data set open, I used the "MGLH/General linear model" option from the Stats menu. T1, T2, and T3 were identified as the dependent variables, the Indep'dent option was clicked so that the CONSTANT term was added to the model. No between-group (or independent) factor was identified. There are three levels of the repeated or within-group factor so the number 3 must be inserted in the Repeat box on the screen for the appropriate analysis to be produced. See *Figure 2* for the completed "General linear model" dialogue box. (Alternatively, you could use the "Fully factorial (M)ANOVA" option from the Stats menu by entering T1, T2, and T3 as dependent variables, CONSTANT as a factor, and 3 in the repeat box.)

If the "Show command window" option from the Goodies menu is chosen before any other menu choice, you can record the commands generated during your session. This command file can be saved, edited, and resubmitted. You may also enter these commands into

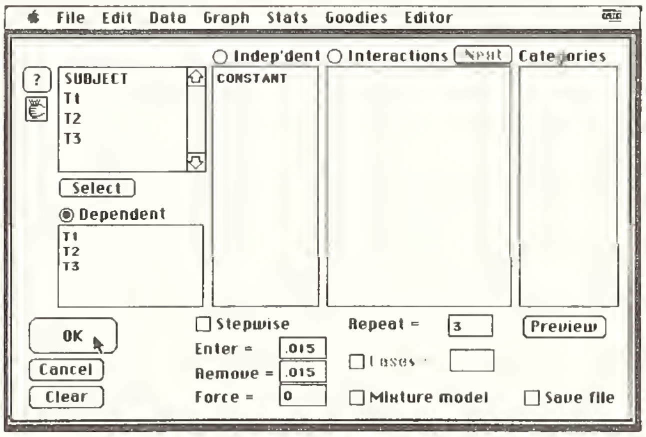
Figure 1



SNAC:SYSTAT 5.0:Keppel 17.3

	SUBJECT	T1	T2	T3
1	1.000	13.000	24.000	22.000
2	2.000	6.000	30.000	29.000
3	3.000	25.000	13.000	23.000
4	4.000	20.000	16.000	25.000
5	5.000	25.000	37.000	16.000
6	6.000	19.000	30.000	12.000
7				
8				
9				
10				

Figure 2



SUBJECT
T1
T2
T3

○ Indep'dent
CONSTANT

○ Interactions

● Dependent
T1
T2
T3

☐ Stepwise
Enter = .015
Remove = .015
Force = 0

Repeat = 3
☐ Cases =
☐ Mixture model
☐ Save file

the command window in an interactive fashion rather than using the menus. *Figure 3* lists the commands captured in the command window when the "General linear model" dialogue box, described above, was submitted.

SYSTAT automatically produces both the univariate and the multivariate analytical results (see *Figure 4*) when analyzing repeated measures data. SYSTAT displays the means for each of the levels of the repeated factor, followed by the univariate results. The univariate test of the hypothesis that the mean levels of T1, T2, and T3 are equal is found in the section of the output labelled 'univariate repeated measures f-test'. The error term is the interaction of subject and the levels of the treatments. Here, the hypothesis is not rejected since the p-value is 0.429. See Keppel, 1982, page 389 for the ANOVA table for this example.

The sums of squares for this hypothesis can be partitioned into orthogonal components representing the polynomial contrasts which, in this case, are the linear component (degree 1) and the quadratic component (degree 2). The individual F-tests are summarized in the section of the output labelled 'single degree-of-freedom polynomial contrasts'. This is default output from SYSTAT where there is the assumption of even spacing between the levels of T. The MGLH/Test option in the Stats menu will allow you to specify uneven spacing or you may choose, instead, to produce the test for differences between the means of adjacent levels of T (the Diff option). Please see section 6.35 of SYSTAT's *Statistics* (Wilkinson, 1989) manual for more details.

SYSTAT gives the results of three multivariate tests, Wilk's Lambda, Pillai's Trace, and Hotelling-Lawley's Trace, which all test the hypothesis that the mean levels of T1, T2, and T3 are equal. See the section in the output labelled 'multivariate test statistics'.

```
>MGLH
>MODEL       T1 T2 T3 = CONSTANT/ REPEAT=3
>ESTIMATE
>
```

Figure 3

```
NUMBER OF CASES PROCESSED:     6
DEPENDENT VARIABLE MEANS
                       T1          T2          T3
                       18.000      25.000      21.167
_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
 UNIVARIATE AND MULTIVARIATE REPEATED MEASURES ANALYSIS
***************************
* WITHIN SUBJECTS EFFECTS *
***************************
TEST FOR EFFECT CALLED:
                   CONSTANT
SINGLE DEGREE-OF-FREEDOM POLYNOMIAL CONTRASTS
      DEGREE       SS         DF     MS           F         P
           1       30.083      1     30.083       0.424     0.543
       ERROR      354.417      5     70.883
           2      117.361      1    117.361       1.317     0.303
       ERROR      445.472      5     89.094
UNIVARIATE REPEATED MEASURES F-TEST
      SOURCE       SS         DF     MS           F         P
  HYPOTHESIS      147.444      2     73.722       0.922     0.429
       ERROR      799.889     10     79.989
MULTIVARIATE TEST STATISTICS
           WILKS' LAMBDA =    0.737
             F-STATISTIC =    0.712   DF = 2, 4    PROB =   0.544
            PILLAI TRACE =    0.263
             F-STATISTIC =    0.712   DF = 2, 4    PROB =   0.544
  HOTELLING-LAWLEY TRACE =    0.356
             F-STATISTIC =    0.712   DF = 2, 4    PROB =   0.544
_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
```

Figure 4

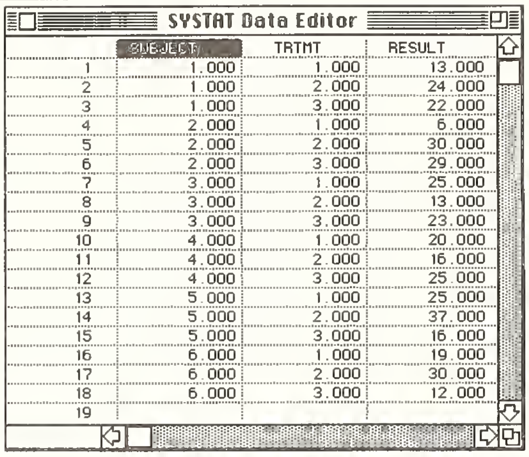
Remember that for the univariate F-test for the repeated factor to be valid, there is the assumption that there is equality of variances and equality of covariances amongst the levels of the repeated factor. Unlike SAS or SPSS, SYSTAT does not provide a way to test for this assumption (usually the test for sphericity). Nor does SYSTAT provide the Greenhouse-Geisser or the Huynh-Feldt corrections to the univariate F-test. As an analyst, you have to be careful in interpreting the analytical results, especially if the univariate and multivariate test results differ. See Cole and Grizzle, 1966, Huynh and Feldt, 1970, and Looney and Stanley, 1989 for further discussions about this topic.

If the data for the previous example were entered in the univariate presentation method (see *Figure 5*), you would have three rows per subject. The column named TRTMT identifies which treatment result is recorded in the next column named RESULT. The univariate test results displayed in *Figure 4* could be reproduced with this new data set in the following manner. Choose "MGLH/General linear model" from the Stats menu. Choose RESULT as the dependent variable and let CONSTANT, SUBJECT, and TRTMT be the independent variables. There is only one interaction, namely SUBJECT*TRTMT. SYSTAT requires that you enter the number of levels of your independent variables in the categories column of the dialogue box (see *Figure 6*). Click on the Preview button if you wish to see the complete model statement.

A fully saturated model has been defined in the previous step and there are no useful analytical results. To test the hypothesis that the mean levels of treatment are equal, choose the MGLH/Test option from the Stats menu. Enter TRTMT as the effect and SUBJECT*TRTMT as the error term. The dialogue box is presented in *Figure 7*. The commands which could be entered in the Command window are displayed in *Figure 8* and the analytical results are displayed in *Figure 9*.

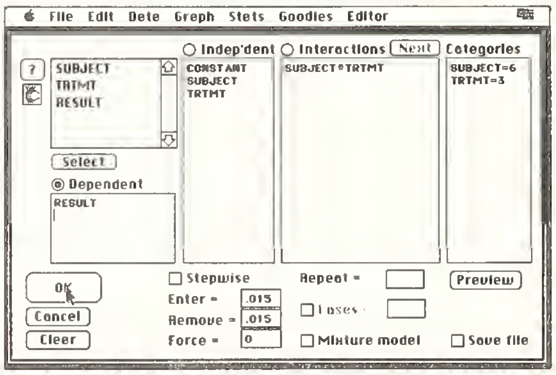
Remember, if you choose the second method of analyzing your repeated measure data, you need to define the complete model and perform the correct F-tests yourself. You will not be able to obtain any multivariate test results with this method. If you are producing analytical results step by step, you may wish to click on Formats/Scroll Analyses in the Data menu. This will allow you to collect all the output before printing.

Figure 5



	SUBJECT	TRTMT	RESULT
1	1.000	1.000	13.000
2	1.000	2.000	24.000
3	1.000	3.000	22.000
4	2.000	1.000	6.000
5	2.000	2.000	30.000
6	2.000	3.000	29.000
7	3.000	1.000	25.000
8	3.000	2.000	13.000
9	3.000	3.000	23.000
10	4.000	1.000	20.000
11	4.000	2.000	16.000
12	4.000	3.000	25.000
13	5.000	1.000	25.000
14	5.000	2.000	37.000
15	5.000	3.000	16.000
16	6.000	1.000	19.000
17	6.000	2.000	30.000
18	6.000	3.000	12.000
19			

Figure 6



SUBJECT
TRTMT
RESULT

○ Indep'dent: CONSTANT, SUBJECT, TRTMT

○ Interactions: SUBJECT*TRTMT

Categories: SUBJECT=6, TRTMT=3

● Dependent: RESULT

☐ Stepwise

Enter = .015

Remove = .015

Force = 0

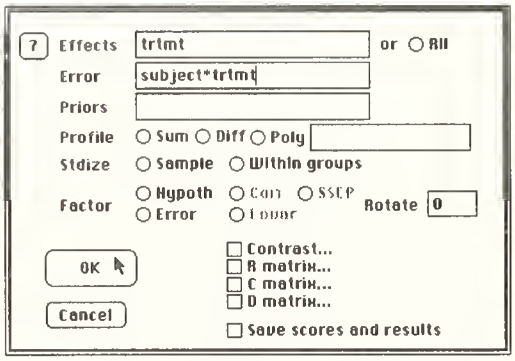
Repeat =

☐ Cases

☐ Mixture model

☐ Save file

Figure 7



Effects: trtmt or ○ All

Error: subject*trtmt

Priors:

Profile: ○ Sum ○ Diff ○ Poly

Stdize: ○ Sample ○ Within groups

Factor: ○ Hypoth ○ Error ○ Corr ○ Covar ○ SSCP

Rotate: 0

☐ Contrast...
☐ A matrix...
☐ C matrix...
☐ D matrix...

☐ Save scores and results

Figure 8

```
>CATEGORY SUBJECT=6 TRTMT=3
>MODEL   RESULT=CONSTANT+SUBJECT+TRTMT+SUBJECT*TRTMT
>ESTIMATE
>HYPOTHESIS
>EFFECT = trtmt
>ERROR = subject*trtmt
>TEST
>
```

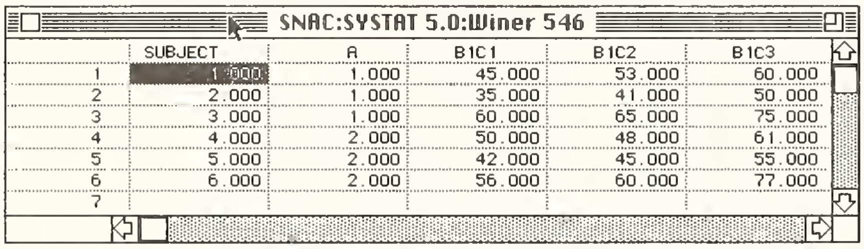
Figure 9

```
TEST FOR EFFECT CALLED:
                      TRTMT
TEST OF HYPOTHESIS
      SOURCE        SS       DF    MS         F         P
  HYPOTHESIS     147.444     2    73.722    0.922    0.429
       ERROR     799.889    10    79.989
______________________________
```

The second example is taken from Winer, 1971, page 546. This design has six subjects divided into two groups, which is recorded by the between-group factor A. The two within-subject factors B and C have three levels each, so subjects are measured nine times. See *Figure 10* for the multivariate data presentation of some of the within-subject factors and the between-group factor. Notice that the variable names for the repeated measures reflect the level of within-subject factors. For example, B1C3, is the measurement for B, level 1, and C, level 3. To analyze these data, I chose the "MGLH/General linear model" option from the Stats menu. The nine repeated measures are identified as dependent variables and the between-group factor, A, is identified as an independent variable in the model. The number of levels in A has to be entered in the Categories column of the dialogue box (see *Figure 11*). In the Repeat box, '3,3' is entered to represent the three levels of B and the three levels of C. The dependent variables are listed in such a way that the level of C changes before the level of B. Only a partial list of the dependent variables appears in the dialogue box. Click on the Preview button to confirm the complete list of dependent variables.

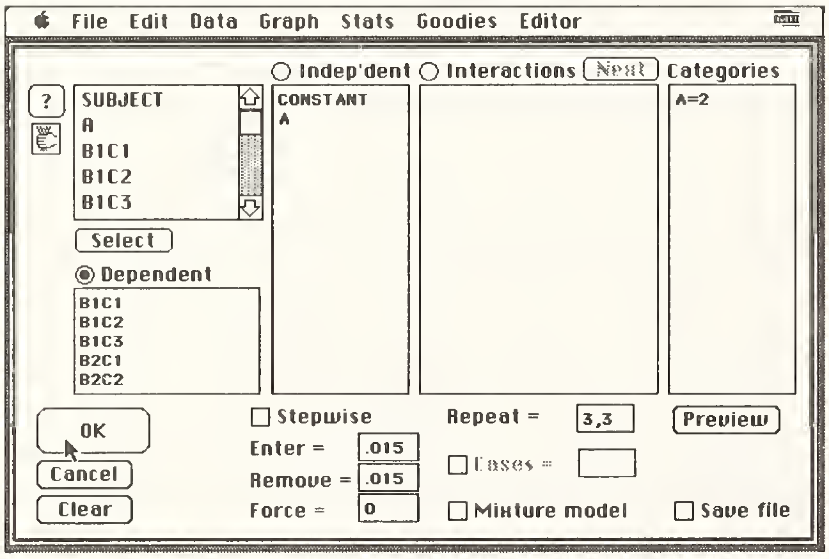
One disadvantage of this version of SYSTAT is that a maximum of two repeated factors can be handled through the dialogue box. Please see the SYSTAT *Statistics* manual, page 280, for details if you need to analyze more than two repeated factors in your data.

The command lines that were generated by the previous dialogue and captured in the command window are displayed in *Figure 12*. I have selected a portion of the analytical results to be displayed in *Figure 13*. SYSTAT automatically produces results for the multivariate and univariate analytical methods. Since the multivariate and univariate results for the between-group factor A are the same, they can be found in the section of the output labelled 'between subject effects'. Here the hypothesis that there are no group differences is not rejected since the p-value is 0.435. To find the test results for the within-subject factors you have to remember the order of the dependent variables. In this example, the within-subject factor B is the 'first trials factor' and C is the 'second trials factor'. I have included the univariate tests results for the hypothesis that there are no differences in the means for the levels of B (rejected with p-value of 0.000)


SNAC:SYSTAT 5.0:Winer 546

	SUBJECT	A	B1C1	B1C2	B1C3
1	1.000	1.000	45.000	53.000	60.000
2	2.000	1.000	35.000	41.000	50.000
3	3.000	1.000	60.000	65.000	75.000
4	4.000	2.000	50.000	48.000	61.000
5	5.000	2.000	42.000	45.000	55.000
6	6.000	2.000	56.000	60.000	77.000
7					

Figure 10



SUBJECT
A
B1C1
B1C2
B1C3

○ Indep'dent ○ Interactions Categories

CONSTANT
A

A=2

● Dependent

B1C1
B1C2
B1C3
B2C1
B2C2

☐ Stepwise
Enter = .015
Remove = .015
Force = 0
Repeat = 3,3
☐ Cases =
☐ Mixture model
☐ Save file

Figure 11

Figure 12

```
>MGLH
>CATEGORY A=2
>MODEL      B1C1 B1C2 B1C3 B2C1 B2C2 B2C3 B3C1 B3C2 B3C3 = CONSTANT + A/ REPEAT=3,3
>ESTIMATE
```

and for the hypothesis that there is no A*B interaction effect (rejected with p-value of 0.029). You should compare the results of these tests with the corresponding multivariate tests before completing your analysis.

The complete ANOVA table for this example can be found in Winer, 1971, page 549. It may be helpful for you to see the ANOVA table before examining all the output generated by SYSTAT. SYSTAT, like other statistical software packages, does not produce a nice summary of the univariate results when there are two within-subject factors.

Figure 14 displays a portion of the data from the previous example in the univariate data presentation method. If you wish to produce the univariate analytical results when your data is entered in this manner, I suggest you read SYSTAT's *Statistics* manual section 6.20 on the analysis of split plot designs. In our example, the six subjects are nested within two groups. SYSTAT requires you to generate two special variables, one for each group, identifying the subjects within the group as 1, 2, or 3 and all other subjects as 0. Together, these two new variables represent the subject nested within group factor which is required to analyze this design. The complete model has to be entered in the dialogue box of the "MGLH/General linear model" option from the Stats menu. The preview of the model is shown in *Figure 15*. This

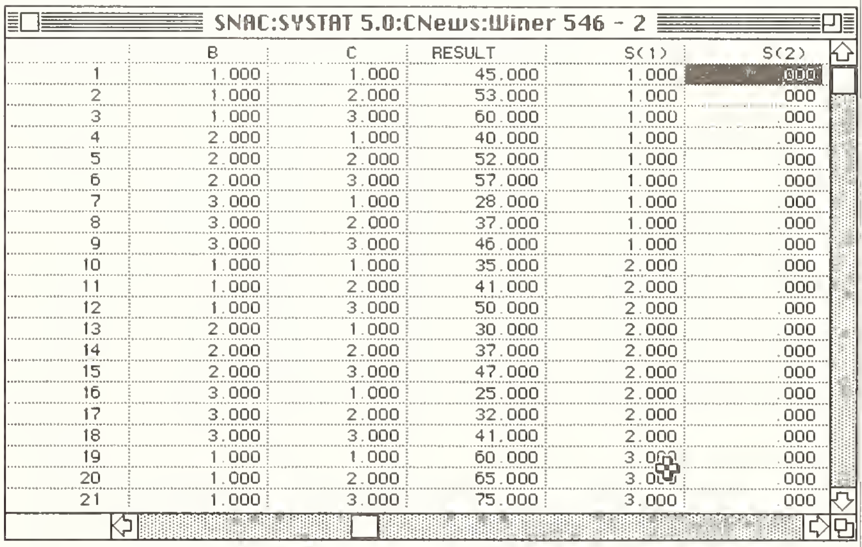
Figure 13

```
****************************
* BETWEEN SUBJECTS EFFECTS *
****************************
TEST FOR EFFECT CALLED:
                          A
TEST OF HYPOTHESIS
      SOURCE         SS          DF        MS          F          P
  HYPOTHESIS       468.167       1       468.167     0.752      0.435
       ERROR      2491.111       4       622.778
_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
***************************
* WITHIN SUBJECTS EFFECTS *
***************************

_ _ _ _ _ _ _ _ _ _ _ _ _
    + FIRST TRIALS FACTOR +
_ _ _ _ _ _ _ _ _ _ _ _ _

UNIVARIATE REPEATED MEASURES F-TEST
      SOURCE         SS          DF        MS          F          P
  HYPOTHESIS      3722.333       2      1861.167    63.389      0.000
       ERROR       234.889       8        29.361
TEST FOR EFFECT CALLED:
                          A
UNIVARIATE REPEATED MEASURES F-TEST
      SOURCE         SS          DF        MS          F          P
  HYPOTHESIS       333.000       2       166.500     5.671      0.029
       ERROR       234.889       8        29.361
```

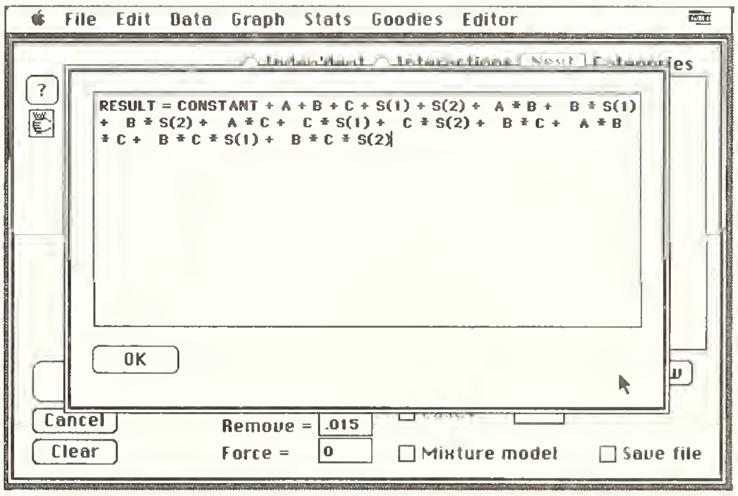
Figure 14



SNAC:SYSTAT 5.0:CNews:Winer 546 - 2

	B	C	RESULT	S(1)	S(2)
1	1.000	1.000	45.000	1.000	000
2	1.000	2.000	53.000	1.000	000
3	1.000	3.000	60.000	1.000	.000
4	2.000	1.000	40.000	1.000	.000
5	2.000	2.000	52.000	1.000	.000
6	2.000	3.000	57.000	1.000	.000
7	3.000	1.000	28.000	1.000	.000
8	3.000	2.000	37.000	1.000	.000
9	3.000	3.000	46.000	1.000	.000
10	1.000	1.000	35.000	2.000	.000
11	1.000	2.000	41.000	2.000	.000
12	1.000	3.000	50.000	2.000	.000
13	2.000	1.000	30.000	2.000	.000
14	2.000	2.000	37.000	2.000	.000
15	2.000	3.000	47.000	2.000	.000
16	3.000	1.000	25.000	2.000	.000
17	3.000	2.000	32.000	2.000	.000
18	3.000	3.000	41.000	2.000	.000
19	1.000	1.000	60.000	3.0[illegible]	.000
20	1.000	2.000	65.000	3.0[illegible]	.000
21	1.000	3.000	75.000	3.000	.000

Figure 15



RESULT = CONSTANT + A + B + C + S(1) + S(2) + A * B + B * S(1) + B * S(2) + A * C + C * S(1) + C * S(2) + B * C + A * B * C + B * C * S(1) + B * C * S(2)

Remove = .015

Force = 0

☐ Mixture model

☐ Save file

is a fully saturated model and you are required to produce the correct F-tests yourself using the MGLH/Test option. *Figure 16* contains the command file to generate all the F-tests required for this analysis. The very long model statement shown in *Figure 15* could be entered into the command window as well. I have not included this statement in *Figure 16* since the text saved from the command window was truncated, i.e., the complete model statement was not saved.

Using SYSTAT Version 5.0 on the Macintosh to analyze repeated measures data is fairly easy to do with the menus available. There is the constraint of having a maximum of two within-subject factors, though. I have been told by a technical support person at SYSTAT, Inc., that SYSTAT Version 5.0 for DOS allows for a maximum of ten within-subject factors. They will eventually upgrade the Macintosh version, but not in SYSTAT Inc.'s recently-announced version 5.1.

If you use the older Macintosh program named SYSTAT Version 3.2, you have to enter the commands interactively from the MGLH module. The command files printed in *Figures 3, 8,* and *12* are valid for Version 3.2, provided that the "greater-than" (>) signs are removed. This older version of SYSTAT is much more awkward to use, and there are memory problems with complicated designs such as those depicted in *Figures 15* and *16*. (Version 3.2 uses 1 megabyte (MB) RAM, and version 5.0 uses 4MB RAM.)

I hope this article has helped you to understand how to analyze repeated measures data using SYSTAT Version 5.0. I have included a list of references which discuss this topic in further detail. If you have any questions please call me at 978-5128 or send an e-mail message to *sgardner@vm.utcs.utoronto.ca.*

```
>HYPOTHESIS
>EFFECT = a
>ERROR = s(1) & s(2)
>TEST
>HYPOTHESIS
>EFFECT = b
>ERROR = b*s(1) & b*s(2)
>TEST
>HYPOTHESIS
>EFFECT = a*b
>ERROR = b*s(1) & b*s(2)
>TEST
>HYPOTHESIS
>EFFECT = c
>ERROR = c*s(1) & c*s(2)
>TEST
>HYPOTHESIS
>EFFECT = a*c
>ERROR = c*s(1) & c*s(2)
>TEST
>HYPOTHESIS
>EFFECT = b*c
>ERROR = b*c*s(1) & b*c*s(2)
>TEST
>HYPOTHESIS
>EFFECT = a*b*c
>ERROR = b*c*s(1) & b*c*s(2)
>TEST
>
```

Figure 16

Comparison of Figures from Part One and Part Two

Part One Nov/Dec	**Part Two Jan/Feb**
Table 1	Figure 1
	Figure 2
Figure 1	Figure 3
Figures 2&3	Figure 4
Table 2	Figure 5
	Figure 6
	Figure 7
Figure 4	Figure 8
Figure 5	Figure 9
Table 3	Figure 10
	Figure 11
Figure 6	Figure 12
Figure 7	Figure 13
Figure 8	
Table 4	Figure 14
	Figure 15
Figure 9	Figure 16

References:

Cole, J.W.L. and Grizzle, J. E. "Applications of Multivariate Analysis of Variance to Repeated Measurements Experiments" *Biometrics*, vol. 22, (1966), 810-828.

Huynh, H. and Feldt, L.S. "Conditions Under Which Mean Square Ratios in Repeated Measures Design Have Exact F-Distributions" *Journal of the American Statistical Association*, vol. 65, (1970), 1582-1589.

Keppel, G. *Design and Analysis, A Researcher's Handbook (2nd Ed.).* Prentice-Hall, Inc., 1982.

Looney, S.W. and Stanley, W.B. "Exploratory Repeated Measures Analysis for Two or More Groups" *The American Statistician,* vol. 43, No. 4 (1989), 220-225.

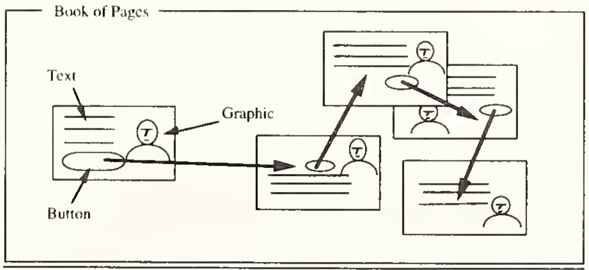
Wilkinson, Leland. *SYSTAT: The System for Statistics.* Evanston, IL: SYSTAT, Inc., 1989.

Winer, B.J. *Statistical Principle in Experimental Design (2nd Ed.).* New York: McGraw-Hill, 1962.

Authoring Systems for the IBM Microcomputer

Geoffrey Rockwell
rockwell@gpu.utcs.utoronto.ca

Linkway and **ToolBook,** two authoring systems for DOS-based microcomputers, are now being supported by UTCS. Authoring systems are a new type of software that allows you to create instructional material easily. An authoring system, unlike a programming language, automates a lot of the work involved in creating programs, making it easier for you to develop certain types of programs. Authoring systems limit you, but within those limitations you can create educational material relatively quickly. We already support HyperCard as an authoring system for Macintosh computer users. Now we are supporting Linkway and ToolBook because we think they are promising tools for IBM PC and compatibles users who want to generate educational material. In this review, we will be discussing Linkway 1.0 and ToolBook 1.0. Version 2.0 of Linkway has been released, but we do not have a copy of it yet.



Overview of authoring.

In both Linkway and ToolBook, your instructional material is organized into a collection of "pages." In Linkway this collection is called a "folder," and in ToolBook it is called a "book." Each page comprises a single screen of text, graphics, and buttons. You arrange the text and graphics on pages for the student, and then link the pages with buttons. The reader of such a work would read a page and then click on buttons with a mouse to go to other pages. The buttons can also be used to do more complex things, such as running an animation or checking a student's answer. For those of you who have heard of HyperCard for the Macintosh, Linkway and ToolBook work in a similar fashion. In HyperCard the pages are called "cards" and the collection a "stack."

Linkway

Linkway is the more modest of the two authoring systems reviewed here. It is less polished than ToolBook, but runs adequately on an XT-class machine. This is its real advantage, as it will run on the sort of machines that are widely available on campus. All you need to do is add a mouse to the computer and Linkway should be able to work. To compare it to ToolBook feature by feature would be unfair since ToolBook was designed to run on a much faster class of microcomputer.

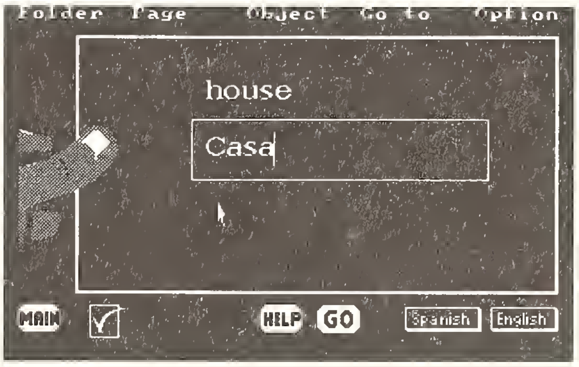
The sophistication of what you create in Linkway will depend on the resolution of your computer screen. If your computer has a CGA video display, you will create Linkway folders that look grainy and chunky. This is not Linkway's fault, but a result of the limitations of your machine. If you have an EGA or VGA display, you can take advantage of the enhanced display and create better-looking folders.

Linkway comes with a set of sample books, such as a language flash-card book for learning Spanish vocabulary. These books can be used as examples of how to build your own.

The limitations of Linkway are many. First, you have a restricted number of typefaces and type sizes from which to choose. Linkway is not a Windows program, so you do not have access to Windows' numerous typefaces and character sets. (Microsoft Windows is a graphical point-and-click interface for PCs and compatible machines, similar to that for the Macintosh.) This means that you cannot easily use special or foreign characters that you might need for foreign language instruction.

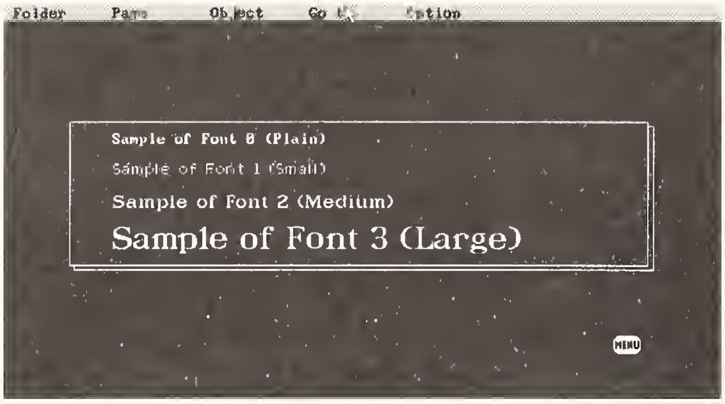
Another limitation of Linkway is the interface. Creating buttons and fields for text is unnecessarily complex. Linkway forces you to go

A page from a Linkway folder.



house

Casa



Sample of Font 0 (Plain)
Sample of Font 1 (Small)
Sample of Font 2 (Medium)
Sample of Font 3 (Large)

A sample of the text available in Linkway.

through a set of unintuitive menus just to create a simple button. I was particularly bothered by the way icons are positioned within a button. An icon is a small graphic that is the part of the button that shows you what the button does. In Linkway, your choice of icons is limited and the icons are not centred properly in the buttons.

In order to make an instructional program attractive and easy to use for the student, you need access to graphics tools. The tools in Linkway are primitive, so you are limited to drawing lines and boxes. However, Linkway comes with a companion program, **LWpaint**. This program allows you to create more complex pictures that you can place on a Linkway page. The latest version of Linkway is supposed to be able to use graphics created in other environments, such as the IBM Audio Visual Connection (AVC) system for capturing images.

By and large, Linkway is adequate for developing simpler applications for slower PCs or compatibles. The manual is reasonably good and the program inexpensive. Finally, a run-time version of the program is available from IBM. With the run-time version you can distribute your instructional materials to others who do not have Linkway. They can use your materials, but cannot develop them further without the full version. You can order Linkway from IBM Direct at (416) 296-8888 for CDN$151. Version 2.0 costs CDN$167.

ToolBook

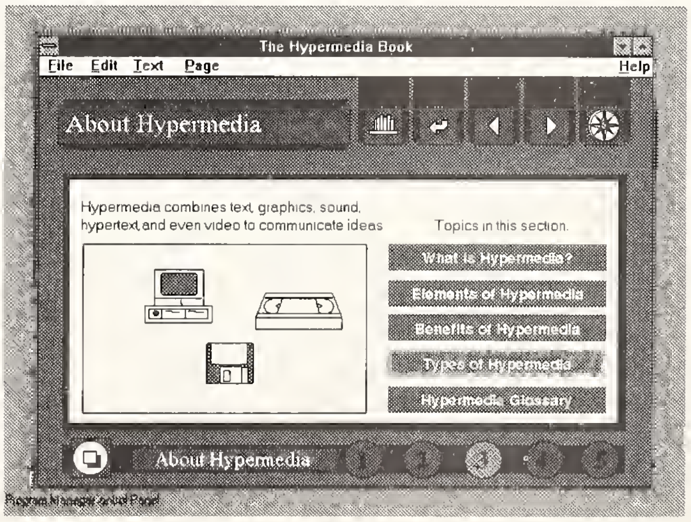
Unlike Linkway, ToolBook is a Windows program. Every copy of Windows 3.0 comes with a read-only version of ToolBook and with some sample ToolBook books that give you a taste of what the full version of ToolBook can do. The read-only version allows you to browse ToolBook books created by others. The idea is that a developer can distribute his/her books, and anyone running Windows 3.0 can read them. You need the full version only if you plan to develop your own books.

Because ToolBook works within Windows 3.0, it takes a fast machine to run it adequately. We found that even on a 386-class machine the program could become irritatingly slow. We hope that as machines become faster and ToolBook is improved, speed will cease to be an issue. For the moment, only those with access to fast microcomputers should consider developing instructional material in ToolBook.

There are many advantages to ToolBook being a Windows program. Any typeface that is available in Windows can be used in ToolBook; text handling is its strong point. A field of text can have text in different sizes, typefaces, and styles. ToolBook also allows you to turn a phrase of text into a button, so that you can have a paragraph of text with different phrases interactively linked to other pages. For example, a student could click on the phrase "Plato's *Republic*" and get a description of this work.

Graphics and animated sequences are important in the development of computer instructional material since they are often an integral part of the pedagogic event. Graphics can be the content rather than the form of the presentation, as in art history material where pictures are the point. ToolBook has some drawing tools built into it. These drawing tools are nicely implemented and far more sophisticated than those in Linkway, but you are limited to "drawing" tools that are adequate for formal drawings, like organization charts, but not for realistic drawings of objects. You have to use other programs to create more realistic pictures. With Windows this is not much of an inconvenience, since you can run a paint-type program and ToolBook simultaneously. You can use the Windows clipboard to transfer graphics and text created in other programs into ToolBook easily. The problem, however, is that ToolBook can only display images of a limited size on each page. The foreground and background are

A page from ToolBook's Hypermedia Book.



Hypermedia combines text, graphics, sound, hypertext and even video to communicate ideas

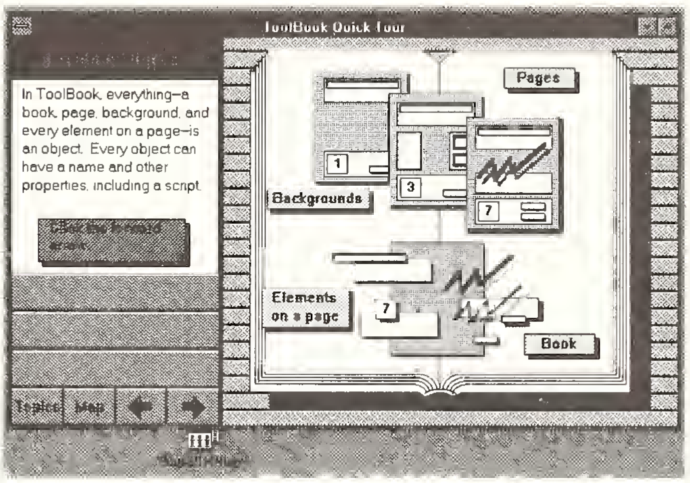
Topics in this section.

limited to 64 kilobytes (KB) of bitmapped graphics each. You cannot have a full-screen colour picture of a heart, for example, as it would occupy more than the 64KB allowed.

Despite the speed and the graphics limitations, ToolBook is a promising authoring system that may become the standard on the IBM just as HyperCard has become the standard on the Macintosh. Because of the similarity in interface, people who have created instructional material in HyperCard will find ToolBook, and to a lesser extent Linkway, easy to learn. All three programs work in essentially the same fashion, with pages (or cards) of text and graphic objects. All three share the same design philosophy and many of the same limitations.

ToolBook is available from the University of Toronto Computer Shop for CDN$399.

A page from the ToolBook Quick Tour.



In ToolBook, everything—a book, page, background, and every element on a page—is an object. Every object can have a name and other properties, including a script.

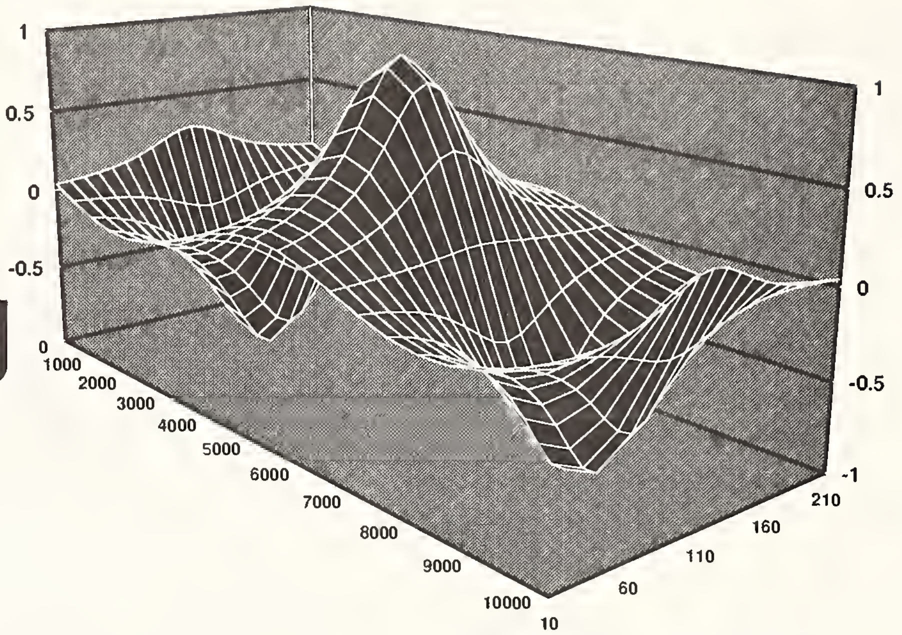
If you are interested in developing instructional material on the computer, you should call Geoffrey Rockwell at 978-4548. While these authoring systems are relatively easy to use, we can assist you in choosing the one appropriate to your needs. Here are some of the steps we recommend you take if you are interested in developing computer-based instructional material.

1. **Become an educated user.** It is useful to get a sense of the medium before trying to create something of your own. Call Geoffrey at 978-4548 to make arrangements to review some existing instructional material. We have products in art history, contemporary history, chemistry, psychology, medicine, and languages. We can obtain others if given advance notice.
2. **Research existing software in your field.** We can help you search for existing software in your field. It is much easier to use an existing product than to create one from scratch.
3. **Choose an authoring system.** Some of the things you should consider when choosing a system are: i) *What type of computer lab can you use to deliver the material to students?* One of the deciding factors in choosing an authoring system is the computer lab you have access to. ii) *What are your colleagues using?* It is always easier to learn and develop if you are part of a community of developers. Find out what others are using on campus. iii) *What systems are supported by your central computing services?* Contact Geoffrey at 978-4548 for a tour of the services related to authoring at the University of Toronto Computing Services.
4. **Learn the authoring system** sufficiently to develop a prototype. It is useful to develop a rough prototype of your material first in order to show people and get criticism. A prototype can give others an idea of what you want to do so that they can advise you better. It also gives you something to show if you are applying for a computer lab or equipment.
5. **Once you have a sound design** you should develop a first version. We can assist you with the development but cannot do the development. Therefore it is important to choose an authoring system that you are confident you can work with. We can assist you with importing graphic images, sound, and video. We have image scanners that can be used by developers.
6. **The first version should be tested** in a controlled situation with a small number of students. We can assist with the testing. Testing will help you identify problems that students are having with the program so that you can create a reliable version of your material.

If you are interested in this area or are presently doing something, give us a call or come in and show us what you have.

For assistance with:	*Call:*	*At:*
1. Previewing existing material	Geoffrey Rockwell	978-4548
2. Bringing a demonstration to your department	John Bradley	978-3995
3. Consultation on Authoring Systems	Geoffrey Rockwell	978-4548
4. Scanning Images	Terry Jones	978-4924

DeltaGraph: Mac Charting for Science and Business



Sample 3D wireframe chart.

Terry Jones
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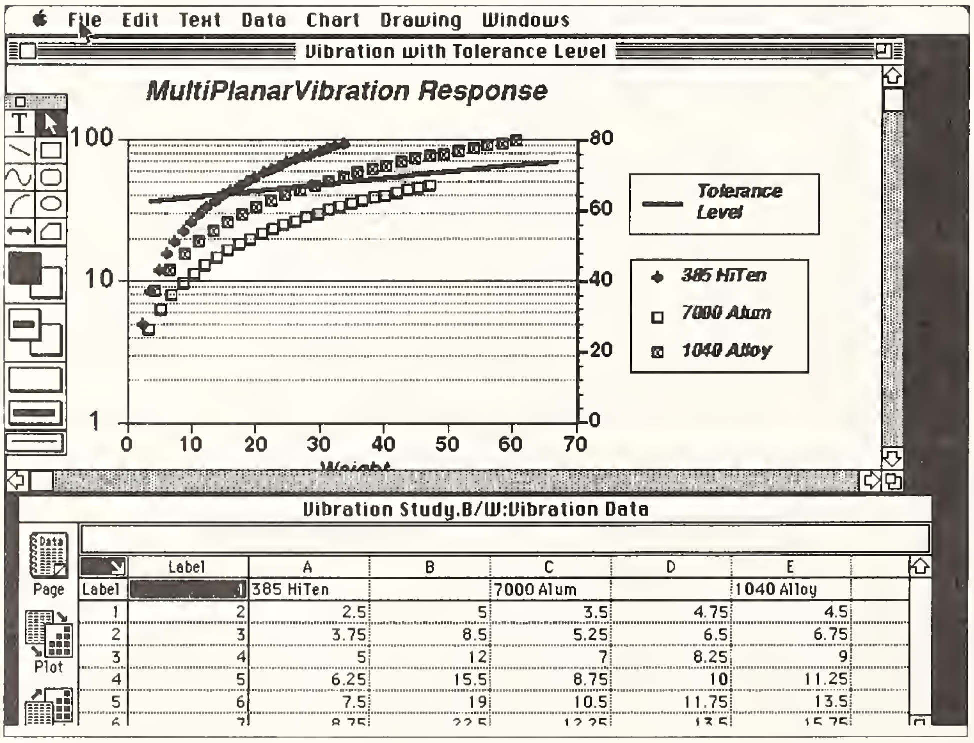
DeltaPoint Inc. has released a Macintosh charting and graphing program called **DeltaGraph**. Hands-on use of this product indicates that it is a capable software package. It is suitable for both scientific and business graphics. It is also very economically priced for the University.

Most charting packages are capable of generating standard business graphs, but fall short when used by the scientific community. DeltaGraph is capable of producing both business charts and scientific graphs suitable for most journals. Not only does DeltaGraph handle bar graphs, line graphs, hi-low graphs, and pie charts, but it also produces table, contour, polar charts; three-dimensional (3D) column (city block), area, ribbon, surface, and scatter charts; and some variations of these. Superscripts and subscripts in labels and annotations are entered easily. The product also treats axes, labels, and titles properly. Axis labels are oriented either vertically or horizontally, or anywhere in between. Tick mark placement and intervals are fully controllable. Axis types include linear, logarithmic, and date/time scaling. Axis values can be automatic or specified.

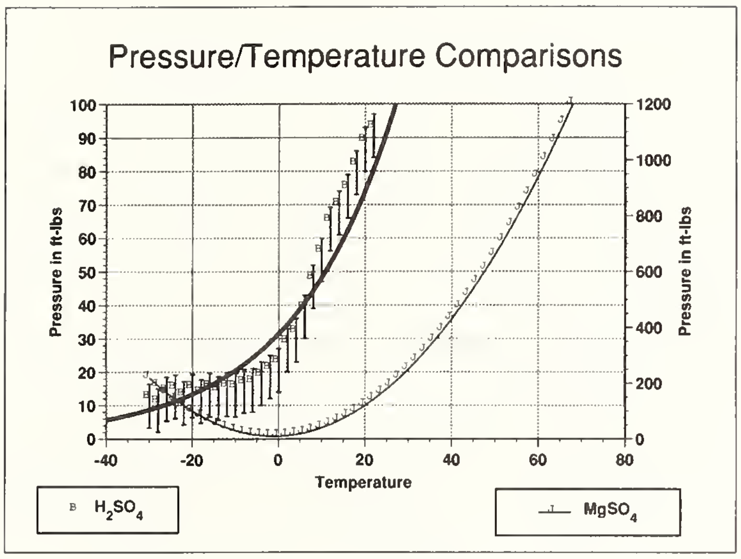
Unlike many charting packages that produce good graphs, DeltaGraph also provides excellent export capabilities so that you can use the charts in other programs. You can export your file in PICT, Encapsulated PostScript (EPSF), Adobe Illustrator, and tab-delimited text format. These give you many options. You can import the PICT and EPSF files directly into desktop publishing and many word processing packages, or you can open the Adobe Illustrator file in Adobe



Vibration Study.B/W:Vibration Data

	Label	A	B	C	D	E
Label	1	385 HiTen		7000 Alum		1040 Alloy
1	2	2.5	5	3.5	4.75	4.5
2	3	3.75	8.5	5.25	6.5	6.75
3	4	5	12	7	8.25	9
4	5	6.25	15.5	8.75	10	11.25
5	6	7.5	19	10.5	11.75	13.5
6	7	8.75	22.5	12.25	13.5	15.75

DeltaGraph edit screens, note tools, spreadsheet-like data, and logarithmic graph.



Note the subscripts, the y-axis labels, and the double x-axes and error bars.

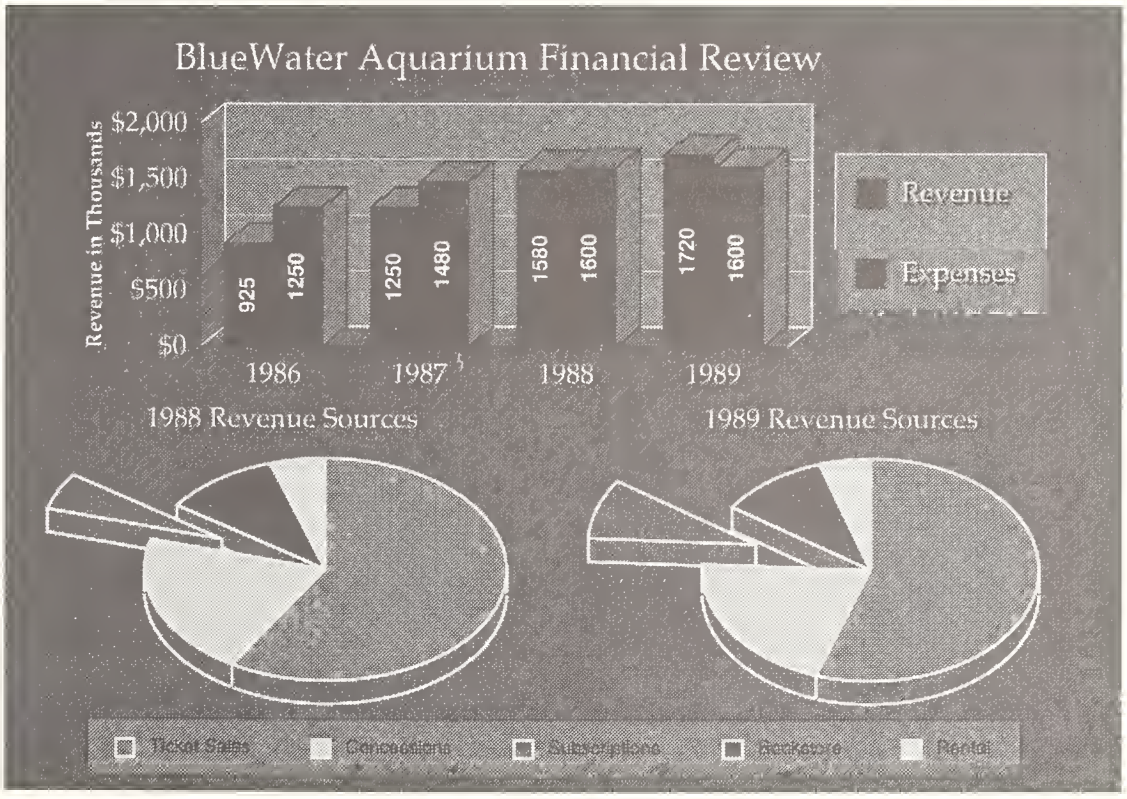
Illustrator, as well as a number of other illustration programs that permit you to edit Adobe Illustrator files. While this is a welcome capability, the tools provided within DeltaGraph are good enough that you can be as creative as you want, right in the program, without going outside to other software for enhancements.

To help you be creative, DeltaGraph has excellent import capabilities. Not only will DeltaGraph import WKS, SYLK, Trapeze, Excel, and text files, but it will also import graphics in PICT or EPSF format, allowing you to produce data charts very quickly and then add imaginative touches just as easily. Also built in is a number of drawing tools for creating lines, boxes, curves, circles, and polygons.

Cost is also one of this program's attractive features. The University of Toronto Computer Shop is in the process of obtaining an educational license, which would offer the program at CDN$79 per copy. By ordering directly from DeltaPoint, using a University purchase order, you get the same version of DeltaGraph for US$50, plus shipping and handling.

In conclusion, this is a highly recommended product! For more information, contact Terry Jones at 978-4924.

Vendor:
DeltaPoint Inc.
200 Heritage Harbor, Suite G
Monterey, California 93940
USA
(800) 367-4334



Sample business style charts.

Atari Portfolio

David Sutherland
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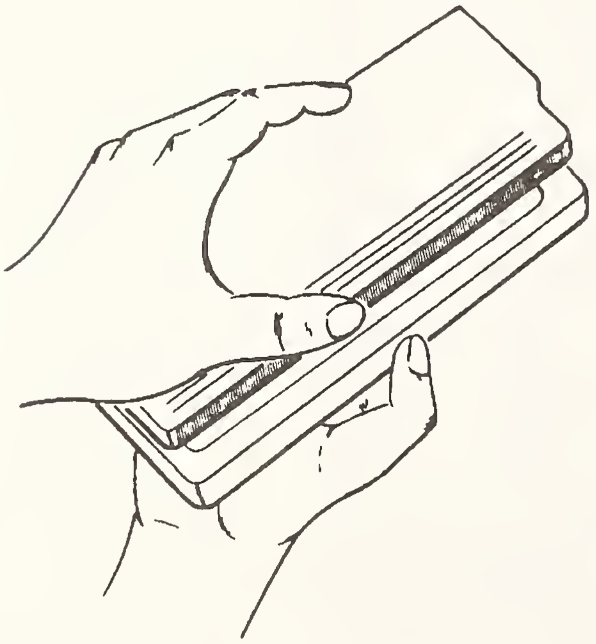
Coming out and saying that I like the Atari Portfolio could be a risky statement. After all, a "techie" is supposed to be dedicated to the pursuit of more and more millions of instructions per second, and larger and larger numbers of megabytes. Recommending a computer that has so few instructions per second and virtually no megabytes challenges some assumptions about what is supposed to make a computer useful.

The key to the Atari Portfolio's usefulness is its combination of weight and price. At ten ounces, I don't mind carrying it around with me. At CDN$350, I might be able to afford one. Its nearest competitor, the Poquet, weighs 18 ounces and costs over $2000.00. Other notebook computers cost over $1000.00 and weigh several pounds.



The Atari Portfolio.

Portfolio Road Testing

Each year the personal computer industry celebrates itself in Las Vegas at COMDEX/Fall, the largest computer trade show in the world. There are over 120,000 people jostling through 20 miles of exhibits at COMDEX–not the best place to try to write. I needed to determine whether I could use the Portfolio to take notes, or if I would find its small size too restrictive, so when the University of Toronto Computer Shop offered me an Atari Portfolio to test drive while in Las Vegas, I accepted.

You should realize that I'm not a natural writer. When I start to write, I get a sentence or two on paper, then cross it out and try again. Rather than an efficient typing machine, what I need is a computer that is close at hand so that I can write while a thought is still fresh in my mind.

With this background information in mind, I had a great deal of success using the Portfolio during COMDEX. When I saw something interesting at a booth, I'd slide the Portfolio out of my case, open the top, and start writing. The small size of the Atari was an advantage; since there wasn't always a lot of room to set up a computer, I was often forced to hold the Portfolio with two hands and type with my thumbs. A typical entry would only be about 20 words, just enough information to jog my memory. Back at the hotel, I would scroll through what I had written, make changes, and add things. Periodically during the day I would save the file to the nonvolatile memory card just in case the computer's batteries failed.

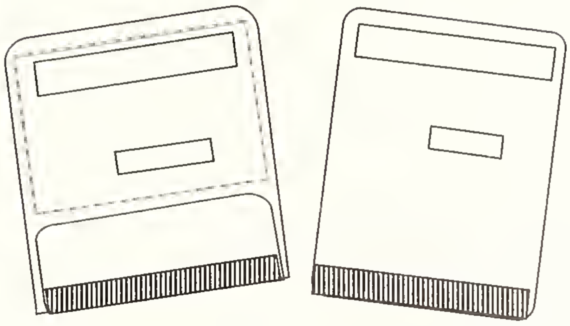
I also used the built-in spreadsheet to record my expenses. I was able to keep a running total of my budget for meals and transportation. When I got back to the office, I transferred the worksheet to Quattro Pro, which simplified the preparation of my expense claim form.

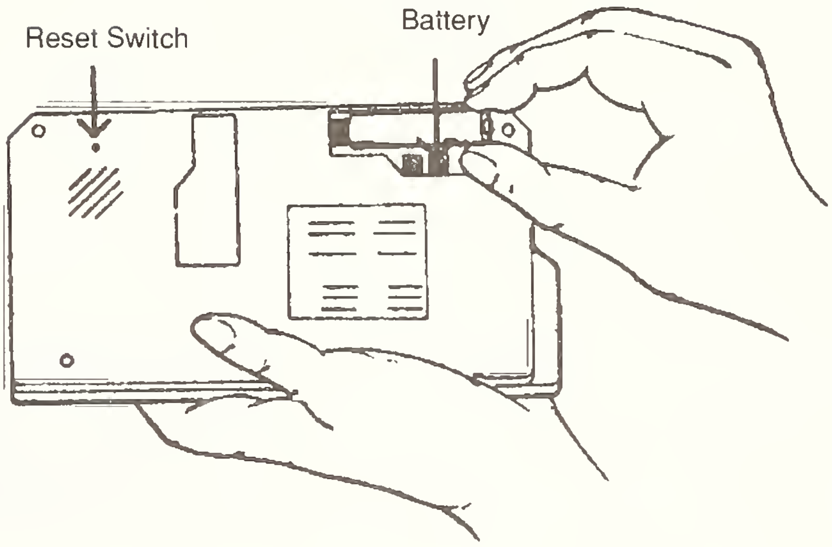
The Portfolio Feature Set

Atari's claims that the Portfolio is MS-DOS compatible are a little misleading. The Portfolio is limited in its ability to run standard MS-DOS programs. It works best with the programs that are written specifically for it. The MS-DOS compatibility also refers to the use of the MS-DOS commands like COPY, CD, MD, DEL, and so on, that are used to manage files on a disk. The Portfolio doesn't have disk drives. A combination of removable Memory Cards and built-in memory are configured to work like disk drives. A Memory Card is a credit-card size device that plugs into a slot on the side of the computer. The card acts in exactly the same way as a floppy diskette, with the advantage of being lighter and providing quicker performance. The built-in battery lasts for a year.

The limitation against using your usual MS-DOS programs isn't as bad as it seems. The Portfolio's

The Portfolio's Memory Cards.





display provides only 40 characters by 4 lines, and most programs would not be very useful under these conditions. The programs bundled with the Portfolio have been written with the restrictions of the display and keyboard in mind. The Portfolio offers a selection of programs that are designed to be attractive to the travelling business person:

Address Book - a mini flat-file database for names and phone numbers;
Calculator - a calculator with five memories, editable calculation tape, square roots, a range of percentage tools, and a number of numeric formats;
Diary - an appointment calendar and diary with alarms;
Text Editor - a simple word processor;
Worksheet - a Lotus 1-2-3 compatible spreadsheet with 127 columns by 255 rows;
System Setup - a facility that configures operating modes; selects French, English, or German operating languages.

These programs can be started directly by pressing a special key combination or through an Applications menu. The computer comes with a quick reference card and a 250-page manual that offers reasonably understandable instructions for using the programs.

The manual also has some useful advice, such as: "Carry a spare set of batteries." Unlike most portable computers, the Portfolio is always on, so the batteries are always draining. I had my machine for over two weeks before the batteries quit, and they were not fresh when I received the machine.

Information Transfers

Exchanging information with your desktop computer can be accomplished in several ways. The slickest is via the HPC301 card drive, a combination of adapter card, cable, and receptacle for the memory cards the Portfolio uses instead of floppy diskettes. Installing the card drive was easy. I plugged the board into my computer and added a line to the config.sys file that loaded the card drive device driver. Once this was done, my system had a new drive called "E:", and I was able to copy files to and from the memory card without any difficulties. Atari also offers adapter kits for the Portfolio that support serial and parallel connections for file transfer and printing.

Is it for You?

I like the Portfolio enough to be disappointed to have to return it. It filled a need I have for simple note taking and arithmetic. Since I prefer to use a paper appointment diary, I'm not sure that I would use the Address Book.

The Portfolio's small size makes it a very personal computer. Deciding whether it meets your requirements is an individual decision. If you are planning to buy a laptop computer and you would like some help deciding which features are important to you, call David Sutherland at 978-5426.

Microcomputer Short Courses

Irene Rosiecki
rosiecki@vm.utcs.utoronto.ca

UTCS offers various noncredit microcomputer courses to faculty, staff, and graduate students of the University of Toronto. These courses cover a number of software programs available for the PC or the Macintosh. Whether you will be typing a thesis on a word processor, or working with spreadsheets, databases, or desktop publishing, we may be able to help you get started.

Our class sizes are small to allow for much individual attention. Continuing support is available upon completion of a course.

The following is a list of the microcomputer courses taught at UTCS:

- Introduction to dBASE IV
- Introduction to Disk Operating System (DOS)
- Electronic Mail Seminar
- Excel on the Macintosh
- Introduction to FoxBASE+/Mac 2.0
- Introduction to HyperCard
- Introduction to Lotus 1-2-3
- Introduction to PageMaker
- ProComm Communications Seminar
- Introduction to SAS on the PC
- Intermediate SAS – Data Processing
- Intermediate SAS – Statistics
- SAS/Graph Seminar
- Microsoft Word on the Macintosh
- Microsoft Word on the PC
- Introduction to WordPerfect 5.1
- Advanced WordPerfect 5.1 Topics

To find out about course dates and registration procedures, or to book a place in any of these courses, please contact Irene Rosiecki at 978-4565. Courses are filled on a first-come, first-served basis. The more popular courses fill up quickly, but waiting lists are maintained in case of cancellations.

UTCS Services

Facilities Managed by UTCS

Administrative Computing
- administrative IMS, DB2, Batch, and TS0
- 3081K processor, 48 megabytes of memory
- MVS/XA operating system

Computer Disciplines Facility/UNIX

SUN 3/280s, 16 megabytes of memory (zero.cdf)
- Computer Science interactive access
- SUN UNIX 4.0.3

SUN 3/280s, 16 megabytes of memory (one.cdf)
- Computer Science interactive access
- SUN UNIX 4.0.3

Computer Disciplines Facility/PC
- 88 NEC computers connected in a Local Area Network:
  •Robarts Library (Rm. 1061A): 37 NEC PCs
  •St. Michael's College (Rm. 107): 26 NEC PCs
  •Sidney Smith (Rm. 1071): 23 NEC PCs
  •Trinity College (Rm. 024) 2 NEC PCs
- MS-DOS with Turing environment
- introductory computer science

Computers in Quantitative and Empirical Science Teaching (CQUEST)
- 52 DEC VT1000 X-window terminals, 20 DEC 2100 workstations connected in Local Area Network:
  •Ramsay Wright (Rm. 211, 213): 29 DEC VT1000s, 10 DEC 2100s
  •Sidney Smith (Rm. 2105): 20 DEC VT1000s, 10 DEC 2100s

Public Sites
- 50 XT100 terminals connected to PACX
  •Robarts Library (Rm. 1061A): 24 terminals
  •Engineering Annex (Rm. 107B): 12 terminals
  •St. Michael's College (Rm. 107): 9 terminals
  •Victoria College (Rm. 208): 3 terminals
  •Trinity College (Rm. 024): 2 terminals

Erindale College Systems

SUN 3/280, 16 megabytes of memory
- instructional and research access using UNIX

VAX 8200, 8 megabytes of memory
- instructional access using VMS
- research access

VAX-11/750, 5 megabytes of memory
- instructional access using UNIX (Berkeley UNIX 4.3BSD)

Institutional Relations System

VAX-11/750, 8 megabytes of memory
- database services to the owner departments using VMS

EPAS Facility
- 4361-5 processor, 16 megabytes of memory
- general VM/CMS services to the owner departments

Ontario Centre for Large Scale Computation (OCLSC)
- Cray Research Inc. X-MP/24
- 2 processors, 4 megawords main memory
- solid state disk (SSD) with 64 megawords of storage
- UNICOS 5.1.10 operating system
- VAX 8350 + MicroVAX II, VAX-11/750, and SUN 3 provide VMS front-end services

> *The mandate of UTCS is to encourage and support the use of information technologies across campus, and to plan, implement, and operate common-carrier networks and certain appropriate central computer facilities.*

UTCS Centrally Owned and Managed

Systems

IBM VM/CMS
Technical Assistance: 978-6602
- General Purpose Timesharing environment
- Hub of the NetNorth network with access to BITNET, EARN and the Internet
- 4381-R03 processor with 32 megabytes of memory
- CP operating system, VM/SP HPO R5
- CMS timesharing system, VM/SP Release 5
- FTP and TELNET access to the campus ethernet, as well as Internet
- RSCS spooling system, Release 2.3

GP UNIX
Technical Assistance: 978-8853
- General Purpose Timesharing under SUN UNIX 4.0.3
- SUN 3/280, 16 megabytes of memory
- access to Linotronic typesetter
- offers a sophisticated and powerful environment for text processing
- offers a sophisticated programming environment suitable for commercial software development or testing
- full access to USENET, an electronic technical information exchange facility
- offers excellent electronic mail facilities and ability to send or receive mail from most computer networks worldwide, such as UUCPNET, ARPANET, NetNorth, BITNET, CSNET, CDNNET

Services

Communications, Networking & Technical Support
Primary Phone: 978-7087
- Communications Group provides communications systems, terminals, modems, data channels: consulting and installation.
- Field Service Group installs and maintains communications and computer systems, particularly IBM PCs and Macintoshes, on a contract basis or on a cost-per-call basis.
- provides consulting on computer systems technology and installs computer systems
- provides access between the IBM systems and machines using UNIX, VMS and other operating systems. Ethernet, Pronet, and IBM TRN technologies are used over various transmission media including optical fibre. More basic communications techniques are also used for moderate speed links.
- provides consulting on local area networking and installs LANS
- provides access to NetNorth (BITNET), the North American Universities Network; ONET, the Ontario Regional Network; CA*net, the Canadian National Network; and USENET, the UNIX networking fraternity
- provides gateway to the US Internet
- will provide a communications solution to department needs on a contractual basis

Information Centre
Primary Phone: 978-HELP
- Provides assistance in use of electronic messaging, including use of Local Area Networks (LANS); NetNorth/BITNET/EARN, the world Universities network; CDNNET, the Canadian X.400 network; ARPANET; CSNET; USENET; and other international connections.
- provides advising, consulting and documentation on:
  - command languages, including CMS and UNIX
  - high-level languages, including FORTRAN, and C
  - packages and libraries, including SAS, SPSS, BMDP, IMSL, and NAg
  - editors and formatters, including XEDIT, ed, nroff/troff
- provides general micro support
  - selection consulting for hardware and software
  - Micro Lab for evaluation of hardware and software
  - advice on University discounts
  - media conversion and data transfer
  - CD-ROM access to software and information discs
  - offers PostScript Laser Printing Service
  - offers 35mm slide production service using Polaroid Palette
  - administers Local Area Network of PCs for Education Facility
  - administers Macintosh Education Facility
- high-quality typesetting
- provide image and typed text scanning
- installs and maintains application packages
- administers site licenses for various software packages

Telephone Listings

Consulting and Enquiries

Applications Support & Advising Supervisor	Alex Nishri	BC214	978-7109
External Marketing Consultant	Ihor Prociuk	BC217	978-6875
Erindale College	Joe Lim	ER2035	828-5311
Information Office	Evelyn Ward	BC201	978-4990
Account & Access Code Enquiries	Phillip Mun	BC101B	978-7148
IBM & Macintosh Maintenance	Kam Mark	BC103	978-5050
Tape Library (Academic Services)	Susan Kovago	MP368	978-7319
Tape Library (Administrative Services)	Miranda Fong	MP368	978-6693
Communication, Networking & Hardware	Rosi Derka-Tseu	BC105	978-7087
UTCS Noncredit Short Courses	Irene Rosiecki	BC217	978-4565

Consulting & Advising Services:	978-HELP
CMS, and GP UNIX userids:	ADVISOR
CMS Userid for mail problems:	POSTMSTR
Network Operations Centre	978-4621
System Status Enquiries (GP UNIX)	978-4318
System Status Enquiries (IBM)	978-7393
Interactive Services 300 (bps)	978-3959
Interactive Services 1200 (bps)	978-3959
Interactive Services 2400 (bps)	978-7239
Interactive Services 9600 (bps)	978-7220

UTCS Directory

Director:	Dr. Warren Jackson	BC118	978-8948	wcj@vm.utcs.utoronto.ca
Associate Director:	Eugene Siciunas	BC116	978-5058	eugene@vm.utcs.utoronto.ca
Managers:				
Communications & Technical Support	Norman Housley	BC121B	978-4967	norman@vm.utcs.utoronto.ca
Information Centre	Don Gibson	BC217	978-7331	don@vm.utcs.utoronto.ca
Internal Systems Support	Ron Vander Kraats	BC121A	978-4428	rvk@vm.utcs.utoronto.ca
Operations Support	Dr. Bob Chambers	MP350	978-7092	
Systems Support	Bill Lauriston	MP331	978-3579	bill@vm.utcs.utoronto.ca

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Committees on Computing

Supercomputer Users' Group at U of T	Chair	Prof. W.R. Peltier	978-2938
Research Board Standing Committee on Computing	Chair	Prof. C.C. Gotlieb	978-2986

Legend:
BC = Bancroft Building
ER = Erindale
MP = McLennan Physical Labs

* NetNorth/BITNET/EARN

Terminal & Advising Sites

Names and Locations

Central Advising Office (CAO), 978-HELP
Engineering Annex (EA, CDF), 11 King's College Road, Rooms 107, 107B, 201
Erindale College (Erin), 828-5339, 3359 Mississauga Road North, Erindale Campus, Rooms 2037, 2039A-B-C, 2045
Ramsay Wright, 25 Harbord St., Rooms 211, 213
Robarts, Robarts Library, 130 St. George St., Room 1061A
Sidney Smith (Sidney), 100 St. George St., Room 1071, 2105
St.Michael's College, 121 St. Joseph St., Room 107
Trinity College, 6 Hoskin Ave., Room 024
Victoria University, 73 Queen's Park Cres., Room 208

Access Hours

Sites	Hours of Access				Restrictions*	Advising
	Mon-Thurs	Fri	Sat	Sun		
CAO	10:00-18:00	10:00-18:00	closed	closed	Research	978-HELP
CDF	24 hrs	24 hrs	24 hrs	24 hrs	Undergrads	No
EA	24 hrs	24 hrs	24 hrs	24 hrs	None	978-HELP for Research
Erin (2039)∆	9:00-17:00	9:00-17:00	12:00-16:00	12:00-16:00	Research	Rm 2005
(2045-46-47)	24 hrs	24 hrs	24 hrs	24 hrs	Undergrads	Rm 2005
(235)†	8:00-22:00	8:00-17:00	closed	closed	None	Rm 2046
Ramsay Wright	7:00-21:00	7:00-18:00	closed	closed	Undergrads	No
Robarts	8:30-24:00	8:30-24:00	9:00-22:00	13:00-22:00	None	978-HELP for Research
Sidney	7:00-24:00	7:00-24:00	7:00-24:00	7:00-24:00	None	978-HELP for Research
St.Michael's	24 hrs	24 hrs	24 hrs	24 hrs	None	978-HELP for Research
Trinity	8:00-23:00	8:00-23:00	closed	closed	None	978-HELP for Research
Victoria	8:30-21:00	8:30-21:00	8:00-13:00	8:00-13:00	None	978-HELP for Research

Sites	Advising Hours
CAO	Monday through Friday, 10:00 - 18:00
Erin	Monday through Friday, 09:00 - 22:00

Legend

* Research includes graduates, faculty, staff.
∆ Key access available.
† Access restricted to building hours.

Computer and Printer Access

Sites	PACX	CDF/PC	CQUEST	Printers
CDF				Y
EA	Y			Y*
Erin	Y			Y*
Ramsay Wright			Y	Y**
Robarts	Y	Y		Y*
Sidney		Y	Y	Y**
St.Michael's	Y	Y		Y*
Trinity	Y	Y		
Victoria	Y			

(Y=yes, N=no)
* Public Printers **Site Only

ComputerNews
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	1989 Index	CNews Index 1989	260	January/February	46
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	25th Anniversary	Twenty-five Years of ComputerNews	260	January/February	15
	3D Graphics	Public Domain 3D Graphics Programs for PCs	267	November/December	35
	3DSUR	Public Domain 3D Graphics Programs for PCs	267	November/December	35
	486 Machines	Impressions from CDMDEX November '89	260	January/February	8
	4th Dimension 2.0.9	Macintosh Database Software	263	May/June	20
A	Abacus	Double Helix 3.0: A Macintosh Database for Academic Use	267	November/December	14
	Accessible Computing	Accessible Computing: Adaptive Technology for Persons with a Disability	266	October	22
	Accounts	Marketing Representative	265	September	11
	Adobe Type Manager	Adobe Type Manager for Windows	267	November/December	17
	Advising	Applications and Advising Support	265	September	3
		Central Advising	265	September	6
		PC Virus Tools	266	October	32
		Reduction in Advising Services	265	September	4
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	Algorithms	CLAM: Matrix-Based Computing Environment for UNIX Workstations	265	September	39
	Allways	Lotus 1-2-3 Version 2.2 Worth the Switch!	263	May/June	6
	Alto	The Macintosh Graphical User Interface	264	July/August	3
	Analog-to-Digital	ASYST and ASYSTANT - Data Acquisition and Analysis Software	260	January/February	32
	Animation	Multimedia: An Introduction	266	October	1
		PHASER – An Animator/Simulator for Dynamical Systems (for IBM PC)	262	April	18
	Anti-Virus	(see Virus)			
	Apple	(see also Macintosh)			
		Apple Research Partnership Program (ARPP)	265	September	5
		ARPP Macintosh Research Symposium	260	January/February	11
		ARPP Macintosh Research Symposium	261	March	19
		New Apple Products	263	May/June	3
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	Applications Development	Focus on Databases	263	May/June	10
		Macintosh Database Software	263	May/June	20
	ARPP	Apple Research Partnership Program (ARPP)	265	September	5
		ARPP Macintosh Research Symposium	260	January/February	11
		ARPP Macintosh Research Symposium	261	March	19
	Artificial Intelligence	The Computer as a Tool	264	July/August	1
	ASPEN	Computing and Communications News from UTCC	267	November/December	26
	ASYST	ASYST and ASYSTANT - Data Acquisition and Analysis Software	260	January/February	32
	ASYSTANT	ASYST and ASYSTANT - Data Acquisition and Analysis Software	260	January/February	32
	AU/X 2.0	New Apple Products	263	May/June	3
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		Multimedia in the Lecture Hall and Lab	266	October	4
		Multimedia: An Introduction	266	October	1
	Authoring	Multimedia Authoring	266	October	16
		Multimedia: An Introduction	266	October	1
B	Bernoulli 20+20	Commodore PC-50 II	263	May/June	33
	Bibliographic Software	Macintosh Bibliographic Software	262	April	8
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		Personal Bibliographic Software	262	April	5
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	Blissymbolics	Apple Research Partnership Program (ARPP)	265	September	5
	BringBack	BringBack Gives You a Second Chance	267	November/December	23
C	Calculations	MathStation: A Computing Environment for UNIX Workstations	261	March	21
	CASim	CASim: Cellular Automata Simulation Program for the Macintosh II	266	October	34
	Catalogs	The MeMo Project	261	March	13
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CHAID	First Annual Academic Conference for SPSS Users	265	September	36
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Chaotic Dynamics	1990 SIAM General Meeting	265	September	38
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CMS	Free NetNorth (Electronic Mail) Demonstration	261,262,263, 264,265,266	Mar,Apr,May/June Jul/Aug,Sept,Oct	
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CDMDEX	Impressions from COMDEX November '89	260	January/February	8
CDMEBAK	BringBack Gives You a Second Chance	267	November/December	23
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	Commodore PC-60 III	267	November/December	5
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Complex Numbers	CMPCALC3 Turns Your PC into a Calculator for Complex Numbers	261	March	25
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	First Annual Academic Conference for SPSS Users	265	September	36
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		New SAS Courses	260	January/February	31
		WordPerfect 5.1 is Here! What's in it for You?	260	January/February	25
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